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A SPORTSMAN OF THE LANDES (FRANCE).

A SPORTSMAN OF THE LANDES.

THE traveler by railway from Bordeaux to Bayonne, in the south-west region of France, will cross a plain extending nearly one hundred miles, from north to south, and open to the Atlantic coast, which displays singular features of landscape scenery. It was formerly a vast wilderness, alternately sandy and swampy, interspersed with numerous larger and smaller lakes, and with connecting creeks, not unlike the ancient condition, we suppose, of the Fen Country in the eastern counties of England. But much of the "Landes" has been profitably reclaimed for cultivation and for useful habitation; great forests of pine now cover the poorer soil, while here and there plantations are seen of the oak or the chestnut, with pasture meadows, orchards, and vineyards, and with farmhouses and villages, in the more favored spots of this district. The western parts of the Landes, toward the seacoast, remain in a wilder state; around the Lakes of Cazau, Biscarrosse, and Aureilhan, due south of Arcachon, the sportsman will find an abundance of game, wild ducks and snipes, as well as hares and rabbits, with uninterrupted space for the exercise of his skill in their pursuit. The rustic people of the Landes, more especially the shepherds and those who tend the herds of cows and oxen, are notoriously accustomed to walk on stilts, by which means they are enabled to traverse the swamps and marshes, or to stride over dikes and creeks, and to command an extensive view, from their elevated footing, over the level plain where they pass their lonely days. Even since the aspect of the country has been greatly changed by modern improvement, they have not altogether laid aside the stilts which are still found an expeditious aid to the performance of a long journey, independently of the common roads; and whenever the countryman takes his gun for 'la chasse," intent on killing a few brace of wild fowl or rabbits, he is apt to be mounted upon these queer artificial prolongations of the human leg. He also carries a long staff with an iron claw at the end of it, by which he can pick up the game he has won, and he is happy to avail himself, like most of our own sportsmen in their shooting excursions, of the assistance of an intelligent dog. This manner of following such pastime in the Landes of south-western France is shown in the illustration on our first page.—*Illustrated London News.*

AN ENGLISHMAN ON AMERICA.

RECENTLY Mr. Mark Whitwell delivered a highly interesting lecture on this large and enterprising country, and the facts he furnished his hearers with being only those that actually came under his observation during his late tour through the United States, the address from beginning to end was a most instructive one. In a conversational manner, the lecturer described the experiences he encountered when journeying, and amongst many matters which he said England might learn from and profit was the absence of drunkenness which he noted everywhere. Although he was in the States for eight weeks, and during that time had mixed freely with the working classes on the quays and wher, ever else he had the opportunity, Mr. Nash and himself only saw five persons during the whole of their visit who were in any way the worse for liquor.

Another feature was the great attention paid everywhere to education. In all the small cities they passed through the most pretentious building in each place was sure to be the school house, and in many settlements—consisting in some instances of only eight or ten residences—the school building could be at once recognized. Another matter which made a great impression upon him, the speaker said, was the respectful and polite manner with which the working classes conducted themselves one toward the other. There was none of that dreadful language with which one's ears were polluted so often in the streets of England, and an incident which came under his notice in New York enforced this on his memory. Owing to the carelessness of one man a block took place in one of the streets, but instead of every driver swearing at the other, there was only a little playful banter, and with perfect good humor every man did his best to extricate himself and the others from the difficulty they found themselves in. Referring to the marked intelligence of the Americans, the speaker said it was to be accounted for in no small degree by the great efforts which were made on all sides for the spread of education. It has been put to him, "What is gained by all this expense?" and the answer he made to his interrogator was that the gain was in the moral condition of the people, which was so strikingly apparent.—*Cardiff Times.*

THE MOSS INDUSTRY IN LOUISIANA.

THE Louisiana moss industry is one of the important industries of New Orleans, and as such demands some attention at the hands of the press. In common with all Southern manufacturing interests, it has its days of flush and its days of gloom in business. At present, however, the depression seems about over, and the trade is attaining its former respectable proportions.

The history of the manipulation of moss is very simple. It is gathered mostly by negroes, who devote a spare hour of the day to such work. After a tree is stripped it is allowed to rest for seven years, during which period of time the moss renews itself. Cypress moss is preferred, as it is the longest and most tenacious of all the varieties. After the moss is gathered it is placed on a sunny spot, and left a month to the action of wind and weather. At the end of that time the grayish bark peels off, leaving the hair almost clean.

Some of the moss requires no manipulation, while other assortments are, in weight, more than half dirt. After being thus dried the material is sold to the plantation storekeeper or to the cross-roads groceryman, and the gatherer receives from 1 to 2 cents a pound for it, according to its quality. The stuff is baled and brought to this city for manufacture.

The gatherers of late seem surprised at the falling off in the prices paid for moss. The reason is simple. The demand is not great, or rather, has not been up to within the last two months, and the quality of moss gathered has not been of a good grade. The gatherers seem to think that dusty and rotten moss should command 3 cents and be worth in the market 4½ cents, because it took as much time to gather it as it does to gather moss that commands such prices. If they would bring in a better article they would have no reason to complain of the smallness of the money paid.

After the moss reaches the factory it is subjected to the action of the washer, which is a large cylindrical arrangement with a wheel inside, which pulls the moss hither and thither, and dashes it through a vat of boiling water and soap, until the stuff is cleaned. Then it is hung out upon the racks to dry.

This done, it is put into the duster, a fan mill, which entirely removes all the dust that may have survived the washing process. As a result, the moss comes into the factory yellow in color and goes out inky black.

The article is then made up into bales according to quality, and lettered with single, double, treble, and quadruple X's. The highest grade, XXXX, can hardly be distinguished from the finest and choicest horse hair. The other grades are consumed mostly in Louisiana.—*N. O. Times.*

CANNED MEATS.

IT is not always convenient to have the larder supplied with cold meats and such delicacies for impromptu lunch parties. In small families a large joint of meat, prepared to be eaten cold, becomes a burden to the conscience long before the last of it has disappeared. It is not pleasant to inflict it upon the family for many meals in succession; and to the frugal housewife it is real misery to see things wasted. Potted meats were for a long time the only substitutes for good old fashioned home cooked meats, and potted meats could not be used conveniently except in the form of prepared sandwiches, "notional" people not liking the unappetizing operation of spreading a paste of meat over their bread.

Americans were for many years dependent upon the English for luxuries of this sort, and a very nice variety they supplied. Chicken, ham, tongue, beef, fish of all kinds, were to be had done up in pretty little jars and convenient to use; but the English preparations were always more highly seasoned than the average American cares to have his food, so that while they were used, they never became popular.

As usual, the enterprising American saw his opportunity, and to-day the English potted meats are almost entirely crowded out of the trade, and immense exportations are constantly being made of the superior American canned meats, fish, vegetables, and fruits. In the first-class grocery stores the American potted tongue is sold for 35 cents per can, a can containing about one pound or a little less; ham is sold for the same price, and it really tastes like ham, and not like mustard and cayenne pepper; chicken is 50 cents per can, and turkey 30 cents. But the achievement in canning meats which places American productions far beyond the English is not in the superiority of the potted meats, but in the preparation of ham, chicken, tongue, and game in such form as to make it possible to have them served whole in the most delicious fashion. A whole tongue is canned, and, instead of being chopped up and pressed into a solid mass, is so carefully handled that it is ready to be served hot or cold in its original form, or can be cut in slices as desired. They are put up in 2½ pound cans, and cost about 40 cents per pound. When one cannot depend upon a cook to prepare a chicken in good style, a curried fowl can be served at a moment's notice if necessary. A few cans of such delicacies stored away make the advent of an unexpected guest a real pleasure instead of an annoyance, as it sometimes is. Curried fowl is 40 cents per pound. A boned turkey prepared with truffles and jelly is only 50 cents per pound and makes a delicious dish.

Whole boneless hams are 33 cents per pound. All American canned preparations come at one-half the price of the English. For some things, however, America is still dependent upon England, such as pheasant, which is $2.50 per can, and English jugged hare $1.25.

Some of the foreign preserves are put up in such dainty bottles, and are so beautiful to look at and so delicious to taste, that many are willing still to pay the extra price. Preserved quinces, apricots, and cherries are nothing short of pictures in their pretty bottles, and imported mixed pickles are actually arranged in landscapes and figures of men and animals, showing great skill and ingenuity on the part of the packers. Most delicately flavored wild mushrooms, which grow in the forests of France, are preserved and called Mico pickles, and sell for 90 cents per small bottle.

For impromptu lunches, as has already been suggested, these preparations are exceedingly convenient, and it would be well for all housekeepers to supply their larder in anticapation of the possible emergency.

The game market has almost disappeared from the face of the universe. Nothing now remains of the overstocked stalls, which were to be found in all directions in the markets last fall, but a few lonely pigeons which sell at $2.50 per dozen, some ducks, $1.50 per pair, and wild geese, $1.25 a piece; turkeys are from 12 to 14 cents for inferior quality, and 14 to 16 cents per pound for choice variety; chickens are from 14 to 16 cents per pound.

In the vegetable markets delicacies from the South attract those who can afford to pay 50 and 75 cents per half peck for green peas; Bermuda potatoes have come down a little and are now selling for $1 per peck; beets from the South are $1 per peck, and tomatoes are 40 cents per quart.

Cut sugar is 11⅛ cent per pound this week in the retail stores, granulated 11 cents, powdered sugar 11⅛ cents, and brown still from 7 to 9 cents. Butter of a good quality is selling for 35 cents per pound; of course there are cheaper varieties, but none fit for table use. A superior quality of rolled butter is still holding its old market rate of 40 and 45 cents. Eggs are 25 cents per dozen; honey, 20 to 25 cents per pound, and maple sirup 15 to 25 cents per pint. In the fish market shad sell for $1.25 for roe shad, $1 for buck; fresh salmon $1.25 per pound; cod fish cut into stakes is 10 cents per pound, live cod 8 cents, and market cod 6 cents. The different frozen or refrigerated fish are still at winter prices, which do not vary much. Muscalonge is from 12 to 25 cents; halibut 18 cents for the fine white variety, and 15 cents for gray; hard crabs are $3 per hundred, and terrapin from $18 to $24 per dozen.—*N. Y. Tribune.*

THE AUSTRALIAN INTERNATIONAL EXHIBITION.

IN our SUPPLEMENT, No. 170, we gave a large engraving of the palace at Sydney, New South Wales, in which the International Exhibition is now in progress, with dimensions and other particulars. We herewith present an additional view, showing not only the building itself, but the general features of the surrounding country. The main Exhibition covers an area of 4½ acres. The Exhibition was opened in October, 1879, and at last accounts was in successful operation. A recent letter in the *American Mail*, dated at Sydney, November 6, 1879, gives a number of interesting particulars, from which we make extracts as follows:

The International Exhibition may now be said to be in full blast. It presents a splendid and varied display in all its departments. No effort has been spared to render it a brilliant success, and the result is gratifying to all who have shared in its construction and maintenance. The afternoon musical entertainments in the Great Hall of the building constitute a rare attraction, and are largely attended. Much taste is displayed in the arrangement of the exhibits, and the various foreign courts everywhere bear a brilliant and animated aspect. The office of the American Commission, which contains a handsome pictorial collection of the President, Cabinet, and distinguished Senators and statesmen of our Republic, commands unusual attention. In a conspicuous part of the room is suspended the large, quaint, original engraving of the signing of the Declaration of Independence, and others illustrative of the history of the United States. The whole apartment is gracefully festooned inside and out with the national bunting, and is essentially American in all its appointments. The court is presided over by Dr. C. C. Cox, Chief Executive Commissioner, whose suave and courtly manners, amiable temper, and executive ability have rendered him exceedingly popular with our own countrymen and foreigners alike. Extraordinary courtesies and many unusual honorable distinctions have been conferred on this excellent officer and accomplished gentleman by the citizens and the press of Sydney. W. Sydney Bradford (son of Governor Bradford, of Maryland), the accomplished, gentlemanly chief clerk, and W. Percy Tilghman, his assistant and special messenger, constitute Dr. Cox's staff. The duties of no section are more promptly and efficiently performed, and none is more attractive to visitors.

The Exhibition is full of interest to strangers. The various kingdoms of Europe have sent their finest specimens of mechanism and most exquisite treasures of art. China, Japan, India, and the islands of the Pacific are represented in their peculiar products, while the various colonies of Australia have vied with each other in the display of the strange and intensely interesting productions of the most remarkable region of the world. The liberal outlay of necessary means, the skill, judgment, and energy with which the Sydney Exhibition has been treated, speak volumes in behalf of the enterprising qualities of the citizens. Regarding the brief notice afforded Americans, the tardy action and meager appropriation rendered by Congress, and other serious embarrassments, the American court makes no discreditable display.

I shall now continue to give some of the prominent exhibits in detail, with the assurance that all will have a full measure of fair play in future correspondence.

The ornate workmanship of the celebrated house of Steinway & Sons, of New York and London, is fittingly represented in the American court by two elegant ebonized pianos, a semi-grand and an upright, which are much admired for the general style of finish as well as for their great capacity and duration of tone.

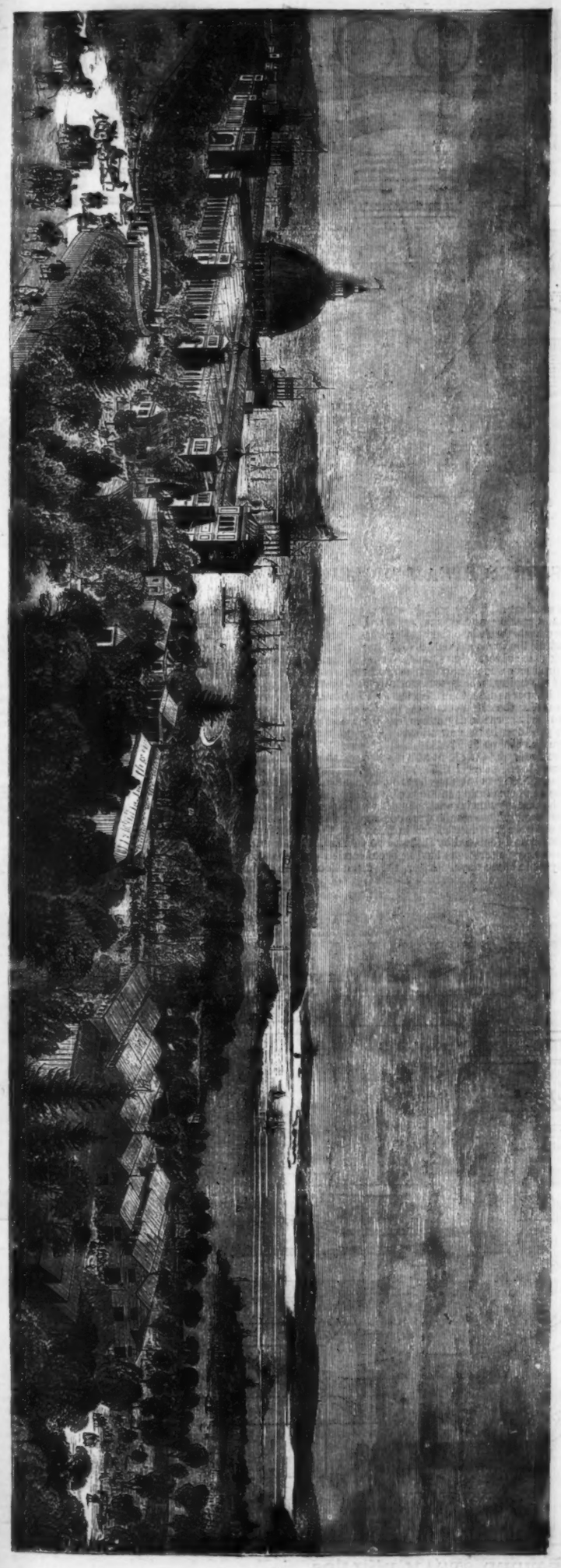
The J. L. Mott Iron Works, of Beekman street, New York, is also worthily represented by Mr. Bechet, of Sydney. The exhibits include fountains, statuary, bath, and wash stands. The fountains are prettily designed, and challenge the admiration of visitors from all parts of the Australian colonies. All are exquisitely finished and a credit to the American artisan.

Simpson, Hall, Miller & Co., of Union Square, New York, and Wallingford, Conn., have made some important alterations in the arrangement of their exhibit of silver plated ware, which enhances the already attractive appearance of their stand. They have added another very large show case to match the one which had been on view since the opening of the Exhibition. The dimensions are 10 feet long, 6 feet wide, and 9 feet in height. The cases are elaborately embellished by handsome signboards.

Turning to exhibits of iron architecture, certainly the most interesting in the Garden Palace is a span of an American bridge which has been erected opposite the north entrance to the main building. It is built of wrought iron throughout, with the exception of the bed plates upon the piers, which are of cast iron. The span is 125 feet in length, and is what is known in America as the "Whipple truss." Onward Bates, C. E., the Australian representative of the Edgemoor Iron Co., of Wilmington, Delaware, is the designer, and has obtained a contract from the government of New South Wales for a bridge of eight spans, seven of which are 125 feet and one of 180 feet in length, to be erected over the Shoal-haven River. This bridge, although intended to be used at first as a highway bridge only, has been constructed of ample strength to carry a railway, and I believe it is the intention of this government ultimately to use it for both highway and railway traffic, in which case footpaths will be added on each side, provision being already made for this purpose. Mr. Bates has, with commendable enterprise, erected one of these spans in the Exhibition grounds in order that colonial engineers and the public generally may give it a thorough examination, as this is the first structure of the kind introduced in any of the Australian colonies. The span is a model of simplicity, and appears to be specially adapted to new countries, where skilled labor is scarce and all labor and transportation expensive.

The Kewanee Manufacturing Company, of New York, is represented in New South Wales by that long-established and prosperous firm, R. Towns & Co., of this city. A Kewanee automatic windmill is in full play on the grounds of the Garden Palace, which, from its lightness and freedom of action, attracts special attention. Although the purchasing operations for the year's supplies do not generally commence until after shearing and harvesting, yet the exhibit under review will change hands during the week, as negotiations are all but closed for its purchase. This very useful implement is peculiarly adapted to the requirements of the Australian settlers. In seasons of drought much difficulty is experienced in obtaining water, and during one year, 1877, upwards of 3,000,000 sheep perished in this country—many of hunger, but the great majority succumbed from the effects of thirst. The Kewanee windmill is destined to obviate a recurrence of such formidable disasters, as it can lift water and force it to a long distance.

E. & T. Fairbanks & Co., of St. Johnsbury, Vt., exhibit a magnificent collection of "Fairbanks' Standard Weighing Machines and Scales." These occupy a large space on the basement floor of the Garden Palace, also in the Machinery Hall and in the American Court. Indeed, I observed that one was used in the shearing shed, where the prize sheep were being shown by competitive shearers from the bush. Mr. Ewing is the representative of the company here. He appears very quiet in business matters, but is just the person to push trade in Australia. It may be observed in connection with Fairbanks' scales that their space on the basement is the largest and best adapted for the purpose; it embraces an area of 1,000 square feet. Their goods have been long and favorably known in Australia, but I understand that the exhibits here are of certain modification to meet the requirements of the climate. The government uses the goods, and they are becoming very popular among the shopkeepers. This is the best show on the basement, though there is a good display from English makers. The latter are now making



THE INTERNATIONAL EXHIBITION, SYDNEY, NEW SOUTH WALES.—THE PALACE, FROM THE STEEPLE OF ST. JAMES'S CHURCH.

strong efforts to beat the Americans out of the market, but "the best horse will leap the ditch" in Australia.

A very pleasing incident occurred a few days ago. Dr. Williams, a member of the firm of Burnham, Parry, Williams & Co., of the Baldwin Locomotive Works, was presented with an address by the American exhibitors at the Garden Palace. Among those present I observed Henry S. Smith, of the firm of H. P. Gregory & Co., of San Francisco and Sydney; William Fleming, agricultural implement importer; G. C. Ewing, of the Fairbanks Scale Company; Onward Bates, C. E., of the Edgemoor Iron Co.; Mr. Nelson, of the Davis Sewing Machine Company; Mr. McCormack, of the White Sewing Machine Company; Mr. Wilson, who represented the Hon. Alexander Stuart, M. P., of the firm of R. Towns & Co.; Harry Graves, of the firm of Reed & Barton; Mr. Hebblewhite, A. S. Spence, E. A. Little, J. M. Rising, H. D. Mills, G. G. Linen; Russell, Ewin & Co.; W. H. H. Lane, who succeeds Mr. Bradford as secretary of the American Commission; Mr. Grace, of D. M. Osborne & Co.; F. A. Abendroth, of the firm of Abendroth Brothers, of New York; P. L. Carman, of Buffalo Pitts Agricultural Works; Gregory P. Harte, of the Winchester Repeating Arms Company; H. T. Smith, of Toronto; C. M. Rosenthal, etc.

GAS-FIRED STEAM BOILERS.

THE enormous consumption of coal which takes place under boilers in generating steam has always made any possible reduction of such consumption a matter of the very greatest importance. On the continent, where fuel is on an average dearer than in England, as well of less heating power, this question has always occupied a larger share of attention than in this country; this is evident both in means employed for raising steam as well as for using it after it has been raised. In boilers abroad we find all imaginable arrangements brought into requisition to extract the least remains of heat from the gases before they finally pass into the chimney, and in engines almost every possible and impossible scheme of valve gear, from the single valve up to six valves, to distribute the steam advantageously in one cylinder, has been used. It is therefore not to be wondered at that under these circumstances further improvements are continually being sought out, the perfect combustion of the fuel being certainly amongst the most hopeful.

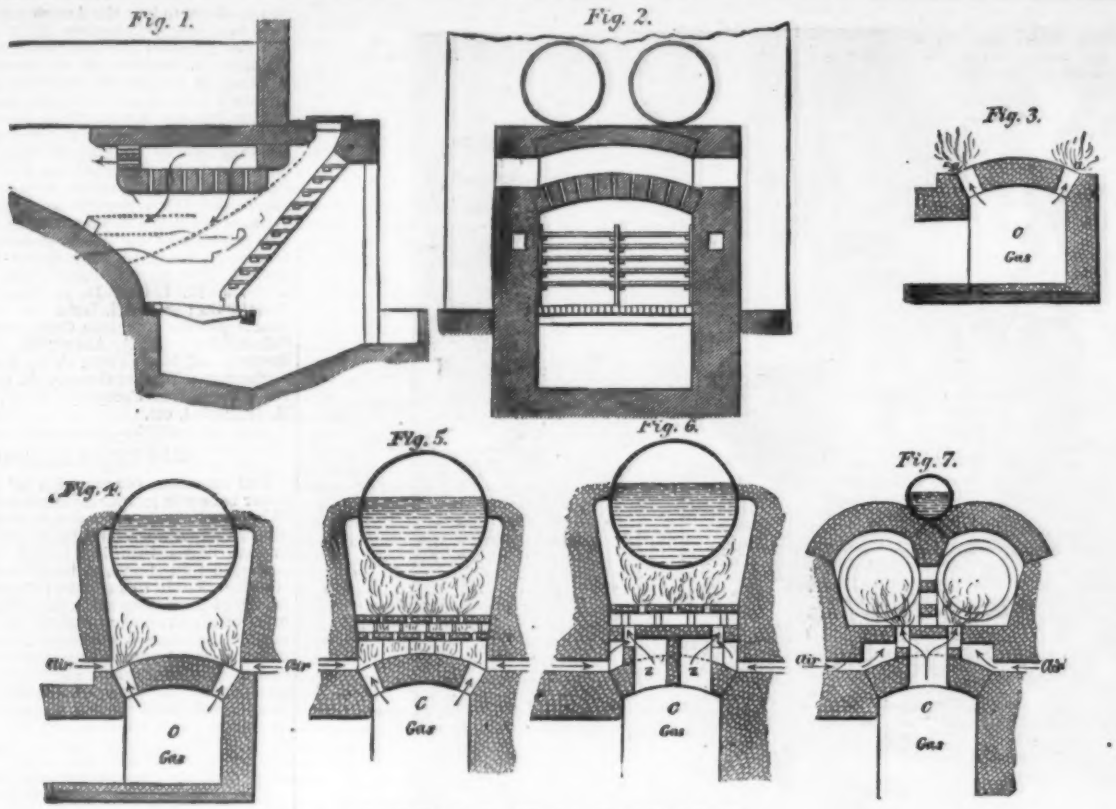
That perfect combustion hardly ever is maintained in practice under boilers fired in the ordinary way is well known, the nearest practical successes in this direction having been attained hitherto by the use of mechanical stoking, which has been used to a large extent, or by blowing in the fuel in a finely powdered state, so that each particle of fuel is in intimate contact with the necessary amount of air requisite for its thorough combustion; this latter system has not, however, up to the present, met with any extended application. Another means of securing perfect combustion is first to distill off the gases contained in the coal, and subsequently to burn them with a proper admixture of air, economy being further promoted by heating this air with the heat otherwise radiated or lost from the boiler.

Among the earlier attempts made with any success in this direction was that by Messrs. Müller and Fichet, of Paris, who arranged a sort of small producer in front of the boiler below the level of the stokehole floor; the gas was led up and mixed with the air necessary for combustion through a number of very small holes arranged in an arch of fire tiles below the boiler; this arrangement had the advantage of providing for a very thorough mixture of the gas and air, but was coupled with the defect that the small partitions in the tiles which formed the edges of the holes got quickly burned away, so that very frequent renewals became necessary. An economy of fuel of 32 per cent. is stated to have been attained with the apparatus when in use. It was experimentally tried in Upper Silesia, Dortmund, and at Essen.

The objections arising from the necessity of such frequent repairs were to a great extent overcome by Mr. A. Heartmann, who designed and set to work the furnaces we illustrate in Figs. 1 and 2 on next page; here, the space occupied by the producer, etc., is practically the same as that taken up by an ordinary furnace. The fuel is introduced through a filling hole in the stokehole floor, falling on the inclined grate, which has a small length of level grate at its lower end, the thickness of the layer of fuel maintained being 6 in. to 8 in. on the sloping part and about 14 in. on the bottom part. From the overlapping of the bars in the inclined part of the grate it will be evident that the fuel cannot possibly fall through unconsumed into the ashpit, and the lowest qualities of small coal and dust can therefore be used. Two concentric arches are built over the producer, having a channel for the supply of air between them, the air mixing with the gas through the openings in the bottom arch as well as in the brickwork uniting the two arches at the end furthest from the boiler front. The constant stream of air entering in this way tends to keep the perforated arch cool and to prevent its rapid destruction by the heat generated.

Mr. Heaupt, of Brieg, has also lately been working in the same direction with a considerable amount of success. His first experiments were undertaken to determine the best means for bringing the gas and air into contact, and Figs. 3, 4, 5, 6, and 7 show the different stages by which he arrived at the most favorable results, Figs. 4 and 5 representing two different arrangements of firebrick arches used for obtaining thorough mixture of the gas and air. The distance from the bottom of the boiler to the top of the fire arch was found to exercise a very marked influence on the results obtained, the most suitable distance having been found experimentally to be about 22 in. to 24 in. The arrangement shown in Fig. 5 was worked day and night for six weeks with small coal from the Florentine pit in Upper Silesia, and the evaporation obtained per pound of coal was equivalent to that of 8·4 lb. of water at atmospheric pressure, and from a temperature of the feed of 32° Fahr. A second trial with a very caking coal from the same neighborhood gave an evaporation of 9·6 pound of water per pound of coal. These results were deemed so very satisfactory that permission was given to fit the apparatus to one of the two boilers belonging to the Lower Silesian Mining Union used for determining the evaporative powers of various kinds of coal.

Figs 8, 9, 10, and 11 show the alterations carried out, these alterations occupying three weeks, and costing £95. In the views given, G is the gas producer, the air for which was forced in by a Körting blower after being heated by passing through the pipes at the sides to a temperature of 185° to 194° Fahr. On account of the cramped space available, owing to the proximity of the other boiler in the same house, the arrangement shown in cross section in Fig. 9 was adopted, but it was soon found to be unsuitable, as owing to its want of symmetry a proper mixing of the gas and air



GAS-FIRED STEAM BOILERS.

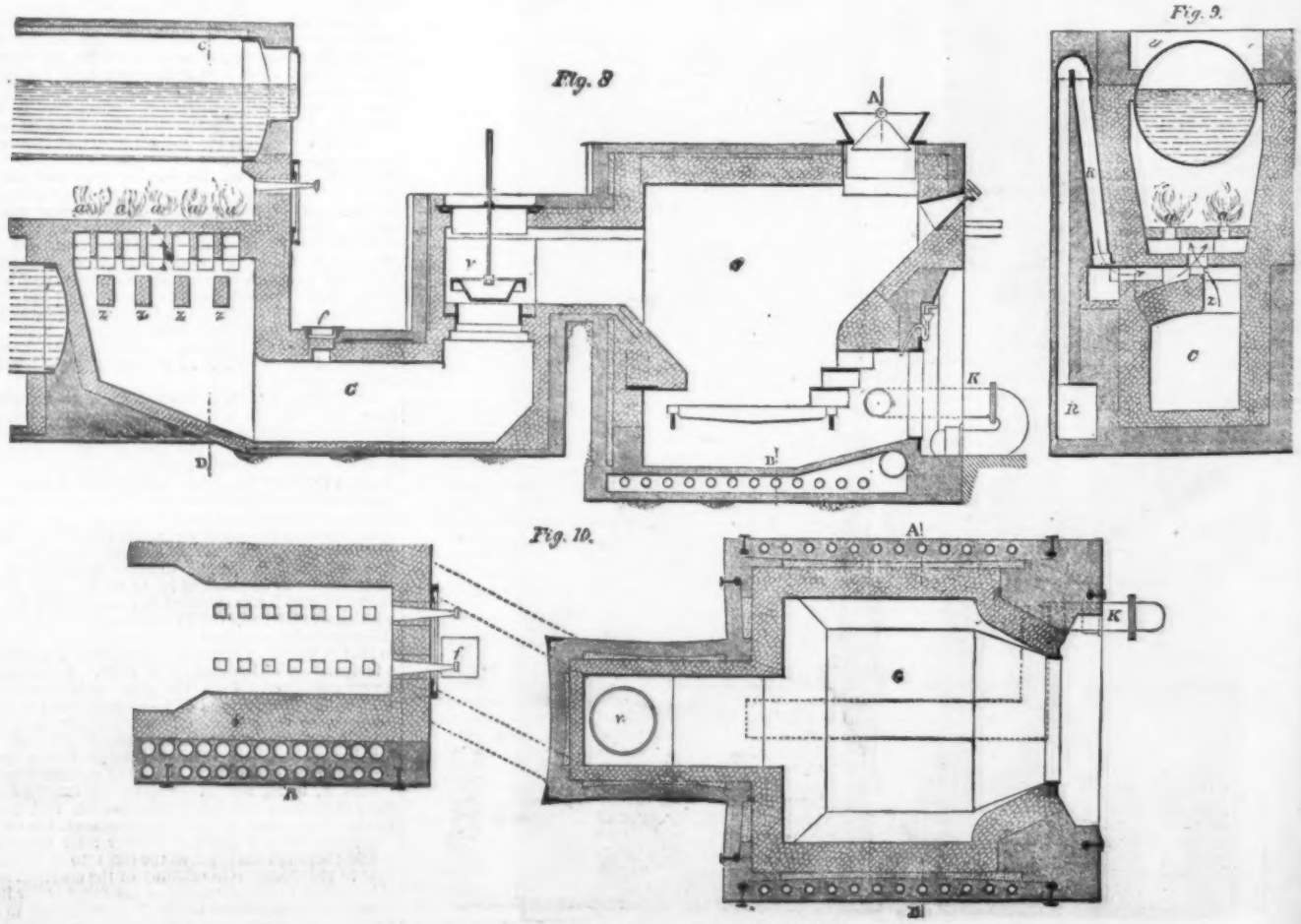
could not take place; an alteration was therefore made, as shown in Fig. 12.

It was observed experimentally that the maximum temperature was generated about the points, *a a*, in Fig. 12, and that at *b b* the temperature had decreased to about 1,770° Fahr. This fact accounts for the durability of the firebrick arches as well as for the immunity of the bottom of the boiler from injury. A good deal of trouble was, however, met with in the management of the producer, particularly as it only worked at most for three days with any single description of coal, the quality of the coal being then changed in order that another variety might be experimented with. If very bituminous coal were used the whole mass fused together in the producer, and was only broken up with very great difficulty; if the coal were very small it produced little gas, and the blast had to be increased, which often cut air ways through the mass, and caused partial explosions.

The maximum evaporations were 8·5 lb. to 9 lb. of water per pound of coal, and the minimum 5 lb. to 6 lb., the actual evaporations being reduced to their equivalents which would have been obtained had the water been boiled off at atmospheric pressure, and the temperature of the feed been 32° Fahr. The greatest difficulty was, however, found in lighting the gas and getting under way at starting. This was done by inserting a torch into the hole of Figs. 8 and 10, but notwithstanding the great care used in doing so partial explosions took place several times, so the whole arrangement of separate producer was abandoned, as those responsible for the safety of the boiler, which was working at a pressure of 90 lb. to 105 lb. per square inch, hesitated to continue the experiments under the circumstances.

In order to arrive practically at the best form and proportions for the producer in its new and simpler type, the experimental furnaces shown in Figs. 13 and 14 were built, the bottom of the fire arch being kept at a distance of about 2 ft. above the grate level; several different kinds of fuel were tried, some containing as much as 50 to 60 per cent. of ashes, as well as the mud remaining in the coal-washing machines, but even with these very unfavorable fires it was impossible to choke the furnace. These results were considered so promising that the separate producer shown in Figs. 8, 9, 10, and 11 was taken down and replaced by that shown in Figs. 15 and 16, all the necessary alterations having been carried out by four bricklayers in three days. After the alterations were completed it was found possible when firing with gas to evaporate 1½ lb. to 2½ lb. more water per pound of coal than had been evaporated when the boiler was fired in the ordinary way; it was also observed that the boiler was capable of generating twice the weight of steam obtained formerly.

In a trial carried on for eleven hours the coal-fired boiler evaporated about 11,000 lb. of water at a pressure of 90 lb. to 105 lb. per square inch, the feed temperature being 60° Fahr. The total heating surface exposed was 430 square feet, or, say, 2,325 lb. of water evaporated per hour per square foot of heating surface; under similar conditions the gas-fired boiler evaporated from 29,000 lb. to 28,540 lb. of water, or, say, from 4·41 lb. to 5 lb. of water per square foot of heating surface per hour, and even at this high rate of evaporation the temperature in the flue leading to chimney never exceeded 662° Fahr. The most rapid evaporation possible to produce with the coal-fired boiler was 19,250 lb., but the temperature of the escaping gases then rose to 932° Fahr., and the evaporation of water per pound of coal diminished to 6 lb. to 6½ lb. The temperature at W, in Fig. 15, was found by Weinhold's pyrometer to be 2,306° Fahr., which is

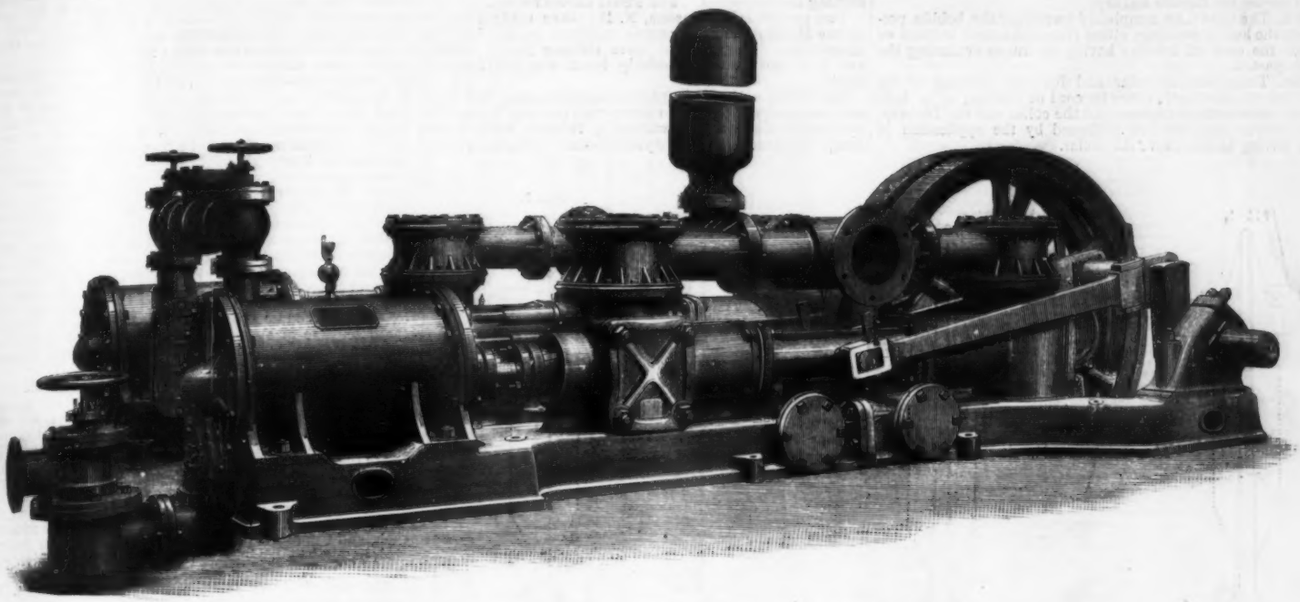


GAS-FIRED STEAM BOILERS.

considered to be much below that often locally generated under boilers fired in the ordinary way; this and the almost perfect uniformity of the heat produced are the principal causes of the moderate wear and tear which takes place in the boilers and in the firebrick arches.

PUMPING ENGINES AT NEWENT COLLIERIES.

WE illustrate a pair of horizontal pumping engines, constructed for the Newent Coal and Iron Company, by Messrs. Frank, Pearn, Wells & Co., West Gorton, Eng. The



PUMPING ENGINES.—NEWENT COLLIERIES.

steam cylinders are 22 in. diameter, with a stroke of 2 ft. The double acting rams are 9 in. diameter, and are calculated to lift 36,000 gallons per hour 280 ft. high. The exhaust is passed through a condenser attached to the suction. The engines can be worked together or separately.—*The Engineer.*

IMPROVEMENTS IN RING SPINNING.

NOTWITHSTANDING the great advantage of the ring throstle or Booth-Sawyer principle, there is one difficulty connected with it which does not appear to have been overcome. Owing to the imperfect method which is usually adopted for mounting the spindles, it becomes necessary, in order to avoid vibration, to make them of large diameter. This necessitates the employment of very heavy tubes, which, besides being expensive, renders the products of ring throstle spinning disadvantageous for export, and even for transport to long distances, while it necessitates the changing of the spindles by the weaver who employs such products, before he can employ them for the purpose of manufacture.

By a new and ingenious arrangement, M. R. Loeffel, of Paris, has succeeded in entirely obviating the inconveniences, and thereby greatly increasing the advantages of ring spinning.

M. Loeffel's invention consists in modifying the ordinary spindle of the self-acting mule, so as to permit of its substitution for the ordinary spindle of the continuous ring frame or throstle. By this means, a ring of smaller dimensions than is ordinarily used, viz., one about 1¼ in., may be employed. To this ring an eccentric is applied of such form, that when the thread arrives at the top of the cop and redescends rapidly, it forms, on account of the high speed, an elongated spiral, that is to say, the filling of the spool is effected in the manner as in the self acting-mule.

This new spindle is fitted so as to turn continually in a foot step which is always filled with oil, which allows of the spindle being driven at great rapidity, and the driving apparatus is placed between the collar of the spindle and the foot, so that it can be operated from below its center of gravity, whereby the vibration is obviated, two small grooves being provided in the collar as reservoirs for oil for lubrication at this point.

This arrangement of the spindle will allow of its being driven by bevel or helicoidal gearing, consequently avoiding all slipping, and these gear wheels are made of "pyrophile" or papier mache, whereby great softness of movement is obtained. There may also be employed for the purpose wharles of vulcanite or hardened India-rubber, driven by a fine iron wire, cord, or steel band.

A delicate point in all ring spinning machines is the joining of the thread, the operator having to stop the spindle in order to join the thread, and then to pass it into the ring, and the difficulty of such an operation may be understood when it is remembered that the operator has to retain the spindle immovable at the same time in one hand.

For stopping or holding the spindle, an arrangement is employed by M. Loeffel which may be operated by the knee, leaving both hands free for the purpose of joining the thread.

In Fig. 1, next page, A is the spindle, about the size of a spindle of an ordinary "mule jenny;" it rests in the footstep, B, inclosed in a box, C, covered by a cover, D, through which the foot of the spindle passes, the box, C, being fixed by a screw nut on the spindle rail, P. The footstep, B, is pierced with small holes, whereby its interior is in communication with the box, C, in such a manner that, the box being full of oil, the footsteps will also be filled and the foot of the spindle turns in oil for the purpose of lubrication. The collar, E, is screwed into a piece, F, and is provided with two grooves full of oil, which also affords perfect lubrication to this part.

In this figure, the driver of the spindle is represented at H, of ordinary kind by pulley and cord, but it may be modified as above described; and further, the pulley or wharle may be made of hardened India-rubber or pyrophile; it carries or is made with a plate or shoulder, A, against which a spring, R, may press at will. This spring is arranged in such wise that if the operative presses it with his knee, sufficient friction will be produced to arrest the spindle.

Very light cop tubes may be employed with this new spindle; it may be remarked that tubes as light as 1800 to the pound avoirdupois have been employed. The tube is shown in place at K. The fixed ring, M, by its rising and falling movement, gives the form to the cop.

Fig. 2 shows an arrangement of gearing, in which the arresting of the spindle is obtained by the means above described, with the addition of a friction cone.

Fig. 3 shows another construction, in which the arrest is effected as in Fig. 2, but the rotation is given by helicoidal gearing.

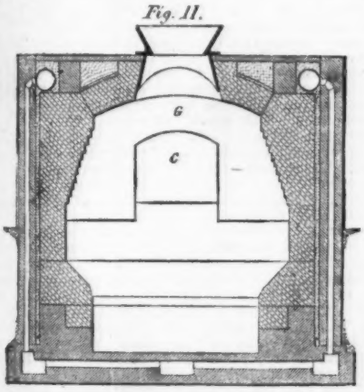
Fig. 4 is a detached view of ring, which may be made in glass or crystal, which will prevent considerable loss.

Thus it will be seen that this improved construction of apparatus presents the following advantages:

1st. It will not be necessary for the weaver to change the spindles of his bobbin frames.

2d. Hitherto it has not been possible to utilize the products of these machines for exportation, and the spinners wishing to employ them could not do so unless their works were in the immediate neighborhood of the weavers, because

Fig. 11.



once an hour, and no difficulty is experienced in stopping at meal times or at night; the producer is merely damped down, and steam is always at hand in the morning ready to commence work. We understand that the last described system is being introduced into this country by Mr. Henry Simon, of Manchester, and we shall probably communicate further results of its working in this country. We are indebted, says *Engineering*, to our contemporaries the *Zeitschrift des Verbandes der Dampfkessel-Uberwachuns Vereine* and the *Zeitschrift des Vereins Deutscher Ingenieure* for our illustrations.

Fig. 12

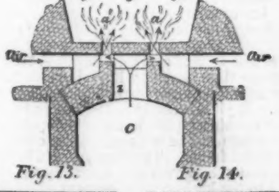


Fig. 13.

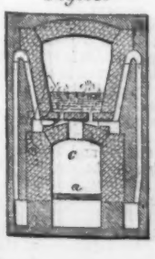


Fig. 14.

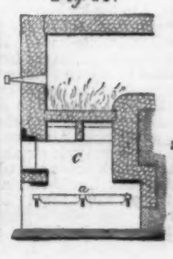


Fig. 15.

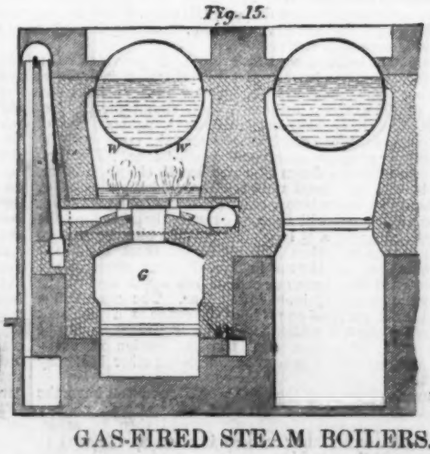
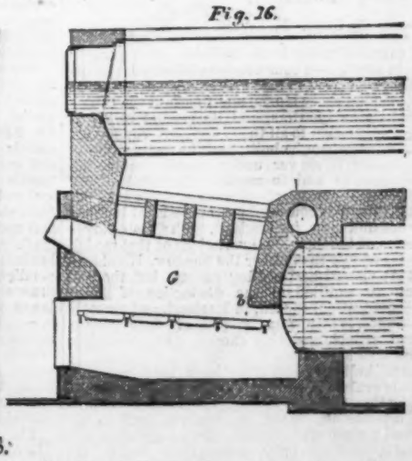


Fig. 16.



GAS-FIRED STEAM BOILERS.

of the excessive weight of the paper tubes. This invention, however, will allow of the goods being furnished freed from the tube, and consequently they may be sent to a distance.

3d. In consequence of the great lightness of the tubes, it is possible to steam the threads, in order to fix the torsion, and render the threads less dry.

4th. The light tube completely traversing the bobbin prevents the loss in weaving, either from entangled bobbins or from the ends of bobbins having no tubes or having the ends pasted.

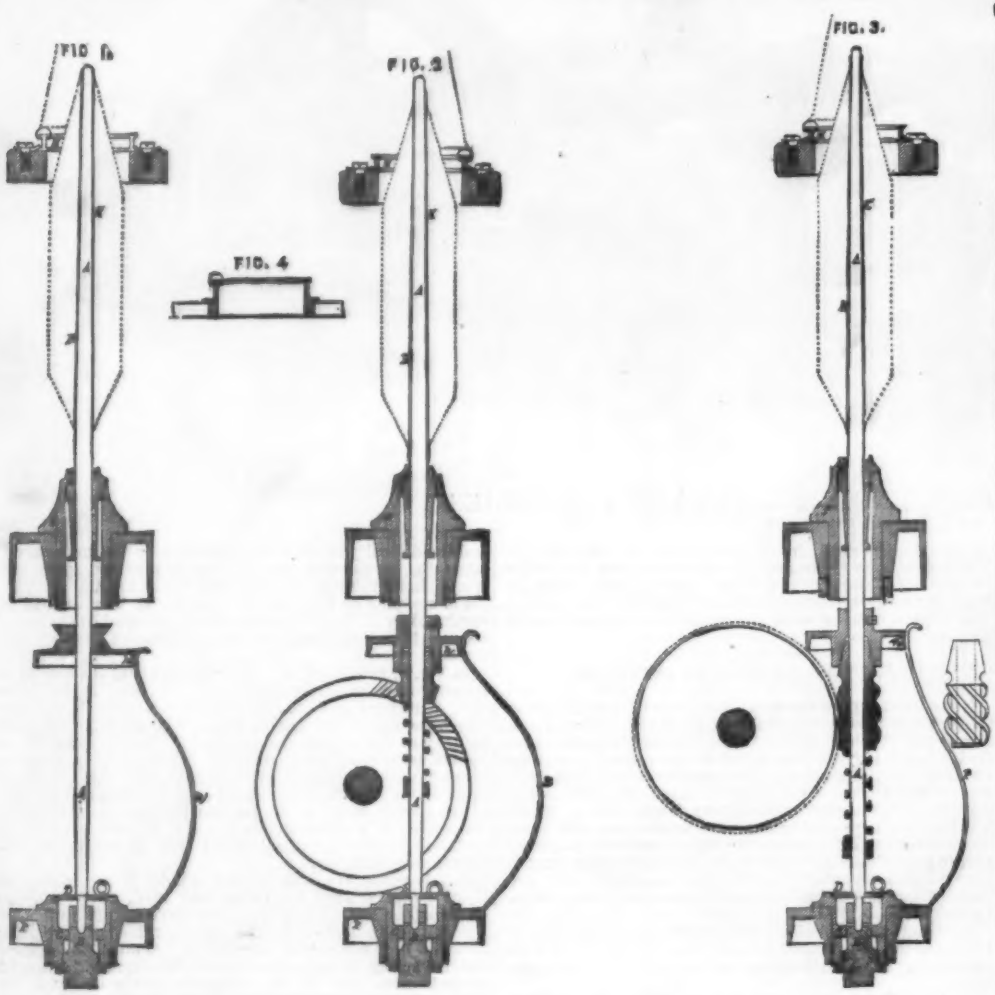
5th. This system of collar and footstep allowing of the driving of the spindle either by cord or gearing, or by helicoidal or worm gearing between the collar and the footstep, will prevent the vibration produced by the application of the driving means above the collar.

6th. The device for arresting the spindle by a spring, leaves the operative perfect freedom for his hands during the joining of a broken thread.

7th. With this construction of collar and footstep, 7,000 revolutions may be readily attained without producing vibration.

8th. The footstep will not require to be supplied with oil more than once in two months, at most, and the foot of the spindle will suffer no appreciable wear, in consequence of its efficient lubrication. The collar needs to be lubricated but once a year, as the grooves in it will retain the oil.

9th. As the footsteps and collars can be displaced, it is always possible to place the rings exactly in the center at the top and the bottom, which is essential for good working.—*Mineral Engineer.*



IMPROVEMENTS IN RING SPINNING.

A LIGHT PADDLING CANOE, AND HOW TO BUILD IT.

By CHAS. E. CHASE.

THE typical canoe of to-day is the solution of a complicated problem in average—a combination of dissimilar qualities to adapt the production to many different purposes. It is built to sail, paddle, carry stores, and to afford the canoeist comfortable lodging quarters, and its general utility is dependent upon adaptation to all these uses. A canoe that will outsail the Shadow can be built, but its better sailing qualities will render it slower under paddle, more unwieldy on the portage and in rapids. The distinctively paddling canoe—the Indian birch, of course, excepted—has not been produced in this country by a professional builder, although it is not unknown in England. The Rob Roy—that is, are flection of the shell—and variations of that model, is speedier under paddle than either the Shadow, Herald, or Nautilus, and are classed as paddling canoes; but they all carry sail, and are entitled to the distinction of being yachts. The classification, indeed, in England, and recently in the United States, is somewhat grotesquely into paddleable-sailing and sailable-paddling canoes. In the United States there are no other classes.

A few amateur builders, however, have built paddling canoes and made cruises in them. The Stormy Petrel was built, in 1875, by Rev. Chas. A. Cressy. She is flat-bottomed, with almost perpendicular sides, the material used in her construction being three pine boards, deck canvas, a few screws and nails, and the paint necessary to impart the finishing touch. The little Petrel came into existence in the clergyman's peaceful study, but has on many occasions shown a refreshing adaptation to breezy places. On her cruise of the Winooski river, in 1875, she ran over the Bolton Falls, lost one of her sides and most of her cargo, but emerged no more used up than her gallant captain; was repaired, and in two days resumed her voyage as though nothing had happened. The Petrel carries no sail.

Two gentlemen of Nashua, N. H., have made a cruise up the Merrimac river in canvas paddling canoes built by themselves. These canoes were thirteen feet in length, and it is said that the midship beam was but fourteen inches.

The writer was one of a party of canoeists that, last summer, encountered on the Hudson a craft that was "propelled by a paddle that was used without a fulcrum fixed to the boat," and hence should be styled a canoe. It was thoroughly home-made—a fine specimen of jack-knife carpentering. Its bow was like a toper's nose inverted, and with an accidental bend to right or left. The stern was the counterpart of the bow. The lines were equally peculiar, and reminded of nothing so much as the lines about the mouth of the unhappy man who has just tasted a green persimmon. The deck sagged just enough to hold a gallon or more of water, until it could be thrown into the lap of the canoeist by a vigorous wave. The paddle was a gigantic double-bladed pudding stick. The craft throughout was original even to the manner of its progress, which was by a serpentine course that made paddling very like sailing against a head wind. Her weight, however, was but 20 lb., and had she been constructed with somewhat greater mechanical skill five canoeists might not have left her as complacently as they did.

A high degree of mechanical skill is not required in the building of a serviceable canoe; indeed it may be assumed that any man who can put up a perverse stovepipe may turn out a fair canoe, in which he may make an all summer's cruise upon American rivers and lakes at a per-diem expense of not more than one dollar. His craft, when he begins his voyage, will not have cost him, counting his labor recreation, more than twelve dollars.

The amateur builder, we will assume, is provided with the tools in common use by wood workers—a jack-plane, smoothing-plane, small wrench, drawing knife, spoke-shave, gimlet, dividers, screw driver, ¼-inch round file, ¾ flat file, 2-ft. rule, large and small hammers, squares, set of chisels, nippers, brace and bits, countersink, cross cut, rip and scroll, or compass saws, and a whetstone. The tool-handle, containing a dozen or more small chisels, gouges, and awls, will be found useful. The midship section or form should be made before work upon the canoe is begun, and upon its shape will largely depend the speed of the craft. Draw upon a ⅝ inch clear, planed pine board two horizontal lines 20 inches long. Connect them by a perpendicular line, as shown in Fig. 1, next page. Then draw a second line, from one end of the upper line to the lower end of the 10½ inch dotted line. The curved line represents the curve of one side of the canoe at a point six inches aft of the *true* midship section. The sides should be exactly alike, of course. Cut the semi-section in pasteboard, and you have a pattern by which the other half may be marked.

Follow the lines with the compass saw, and you have the midship mould for a paddling canoe.

The two watertight bulkheads should then be made. They should be of clear, thoroughly seasoned planed ½ inch pine. If the wood is not well seasoned it will check, warp, and shrink. The amateur must draught them by the eye. The deck width may be 11 inches and the depth 11½ inches. The four slots on each side must be just wide and deep enough to receive the lateral strips. The position of the strips is largely determined by these slots. They must be given easy, graceful curves, but must have no unsightly twists. The amateur is cautioned that until he has built one canoe and secured satisfactory patterns, it is better to reserve cutting the slots until by actual trial with the strips he has determined just where they should be.

The builder should now have at hand a hackmatack knee, or, perhaps two—the best material for stem and stern posts. It should be 1 inch thick and planed. Knees may be procured at any boat builder's shop or ship yard. If a hackmatack or chestnut knee cannot be had pine may be used, but it is imperative that it be thoroughly seasoned. The hackmatack knees afford a natural curve, and therefore possess great strength, while pine must be cut across the grain. To secure a pattern for the stem and stern posts draw upon a piece of thin, planed pine stuff two parallel lines, 13 inches apart and 24 inches long. Set the divider so that the points shall be 13 inches from each other. Place one point at the extreme right hand end of the upper line and the other point upon the same line. Then strike a quarter circle which will intersect with the lower line, and continue the curved line thus drawn by a horizontal line to the extreme left hand end of the lower parallel line. This gives the outer line of stem and stern posts. The head of the stem and stern posts is a semicircle 1¼ inches in diameter.

To strike the inner line set the dividers so that the points shall be 12 inches from each other. Place one point on the upper line and the other one inch above and very slightly to the left of the point of intersection of the lower parallel line and the quarter circle already drawn. Then strike the second quarter circle from that point to the upper line. This second quarter circle is continued by a horizontal line, 1 inch above the lower line, to a point 5 inches from the line A, shown in the following diagram. From that point a perpendicular line should be drawn downward ⅛ inch, and from its lower point a 5 inch horizontal line carried, parallel to the lower line, to the line A, giving the scarf.

This pattern should be sawed out. It should then be laid upon the hackmatack knee and its form traced with a pencil. The hackmatack must then be sawed out, of course. It will be observed that stem and stern posts are exactly alike.

The stem and stern posts are now to be neatly beveled down with drawing knife and plane, from 1 inch at the inner to ¼ inch at the outer curved line, after which four slots, running from nothing at the inner curve to ¼ inch depth, may be made to receive the lateral strips, although, as has already been suggested, this part of the work may be deferred. The eye in the head of the post, intended for the painter, may be bored with a ½ inch bit.

The keelson should be 1 inch square, ash. Its extreme length is 10 feet 10 inches, 5 inches at each end being cut for the scarf.

The lateral strips should be clear, planed spruce, 1 inch wide and ¼ inch thick. It is well to make the gunwale strips 1¼ inches wide, and to put in an inwale. We are now ready to set up the canoe, and if the work has been well performed she will show graceful lines, even if she is only a skeleton. Bolt the stem, A, and stern, B, posts to the keelson, C, using two ⅛ inch bolts at each scarf, not forgetting to coat the scarf and the bolts with white lead. Neatly countersink the bolt heads, of course. Then set up the water-tight bulkheads, D D, 3 feet 7 inches from stem and stern posts, and securely fasten them in place with light iron angles. The midship mould, E, must then be set up at a point 6 inches aft of the true midship section, or, in other words, 7 feet 6 inches aft of the stem post. It is to be removed at a later stage of the work. The lateral strips are now to be put on. The slots in the stem and stern posts and watertight bulkheads, into which the strips are fastened with brass screws, should be coated with white lead. The strips should be rounded off, that there may be no sharp edges or angles. The lines formed by the strips upon one side should correspond with those upon the other, otherwise the canoe will *wobble* when under paddle. Ribs, ½ inch wide and from 6 to 8 inches apart, may now be put in. They may be made of flour barrel hoops, and should be fastened to the strips with copper tacks.

We now have the skeleton of an undecked canoe. The deck beam should be of pine, ½ inch square being quite heavy enough. The well hole, or deck opening, may be square or elliptical, as the builder fancies, the former being more easily finished. The deck camber should be about 3 inches. A 1½ inch coaming, or washboard, should be run around the well hole. The midship mould may now be removed.

The floor board should be of pine, not more than ⅛ inch thick, 3 feet 3 inches long, and 8 inches wide. It is screwed to two blocks that are firmly secured to the keelson.

The common stretcher, or foot-brace, may be fastened to the floor board.

The frame is now complete and ready for the covering. This is to be of canvas, not the coarse, heavy stuff of which ships' sails are made, but light, fine, and strong material. It must be of the very best quality. Canvas is the best of all low priced materials for the sides and deck of a canoe. It requires no waterproofing before it is put on. Every camper knows that common sheeting, that is much lighter and looser than canvas, will shed water for hours. It is superior to wood, in the respects that it will neither warp nor check. It yields readily to the bumps that any canoe must take in running rapids, but quickly springs back into shape. The canvas must be wide enough to cover the bottom and sides of the frame. The frame should be turned deck downward, and the canvas laid smoothly on. It is then to be tacked to the keelson with copper tacks, at intervals of every three or four inches, the points at which tacks are driven being first white-leaded. It is then to be cut to follow the stem and stern posts, to the face of which it is to be tacked. Then it must be drawn tight, and fastened in the same manner to the inside of the inwale or gunwale strip. It may be tacked to the bulkheads. The deck canvas is easily put on. It should be fastened to the outside—not the *inside*—of the gunwale strip. A narrow beading around the canoe at the top of the gunwale streak and around the coaming will conceal the tack heads and edge of the canvas. Nickel-plated round tack heads add a finishing touch. The stem and stern post bands should be of ⅛ round nickel-plated copper.

The canoe should now receive two outside light coats of oil and white lead. It may be well to paint the inside, but it must be borne in mind that white lead is heavy, and that the amount of it that an industrious piece of canvas will ab-

A LIGHT PADDLING CANOE, AND HOW TO BUILD IT.

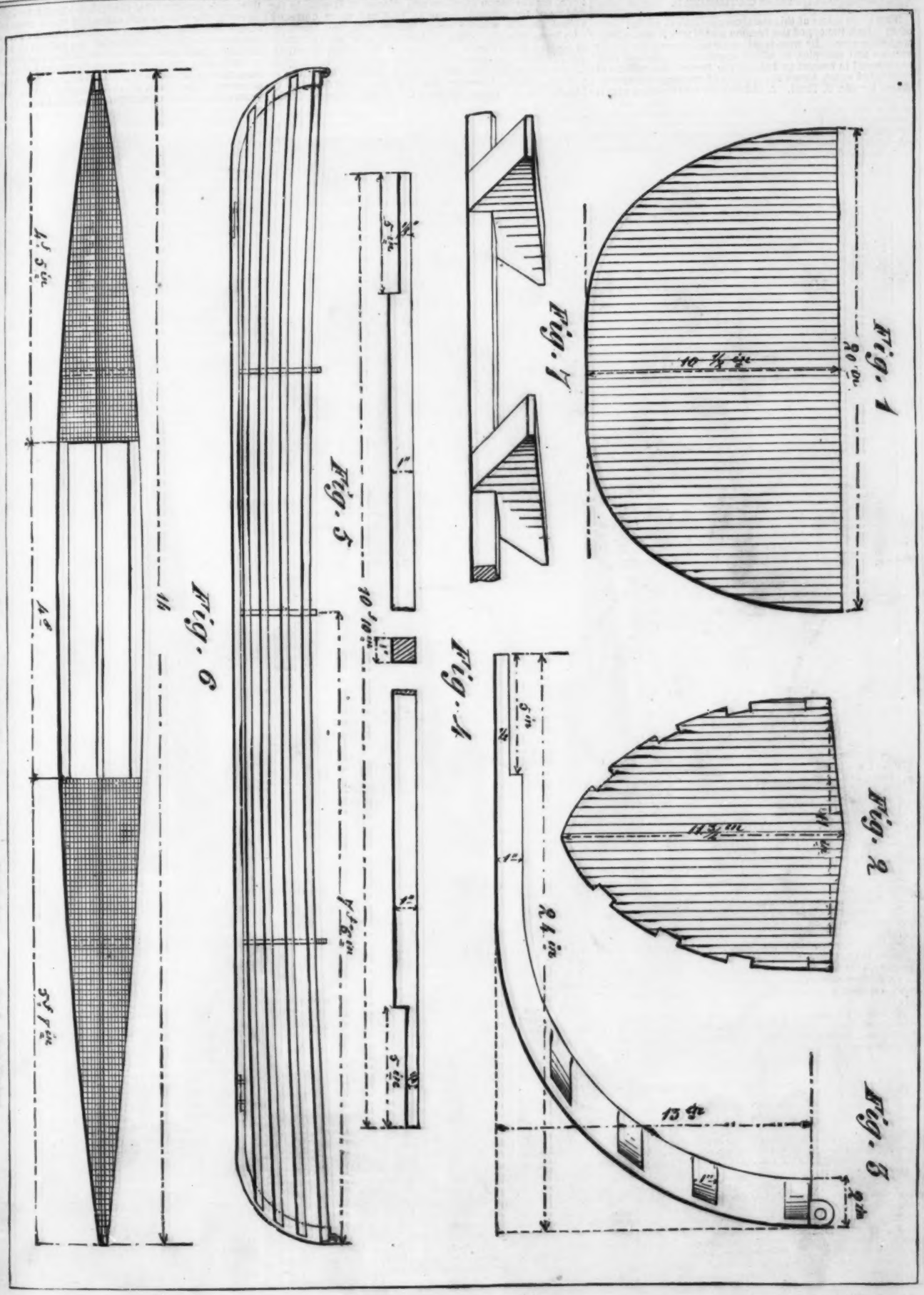
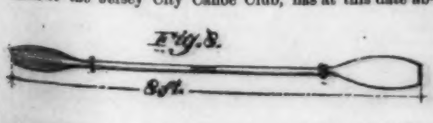


Fig. 1.—Midship Mould. Fig. 2.—Waterlight Bulkhead. Fig. 3.—Stem and Stern Post. Fig. 4.—The Keelson. Fig. 5.—Deck Timbers.

sorb is only a little short of unlimited. The Mate, a canvas canoe of the Jersey City Canoe Club, has at this date absorbed twenty-two pounds, as is shown by the painter's bill. After the two light coats the canoe may be painted to suit the fancy of the canoeist. Unpainted, this little craft will weigh no more than twenty-five pounds. She is built for speed under paddle, and carries no sail. The paddle should be double-bladed, jointed, and 8 feet long.

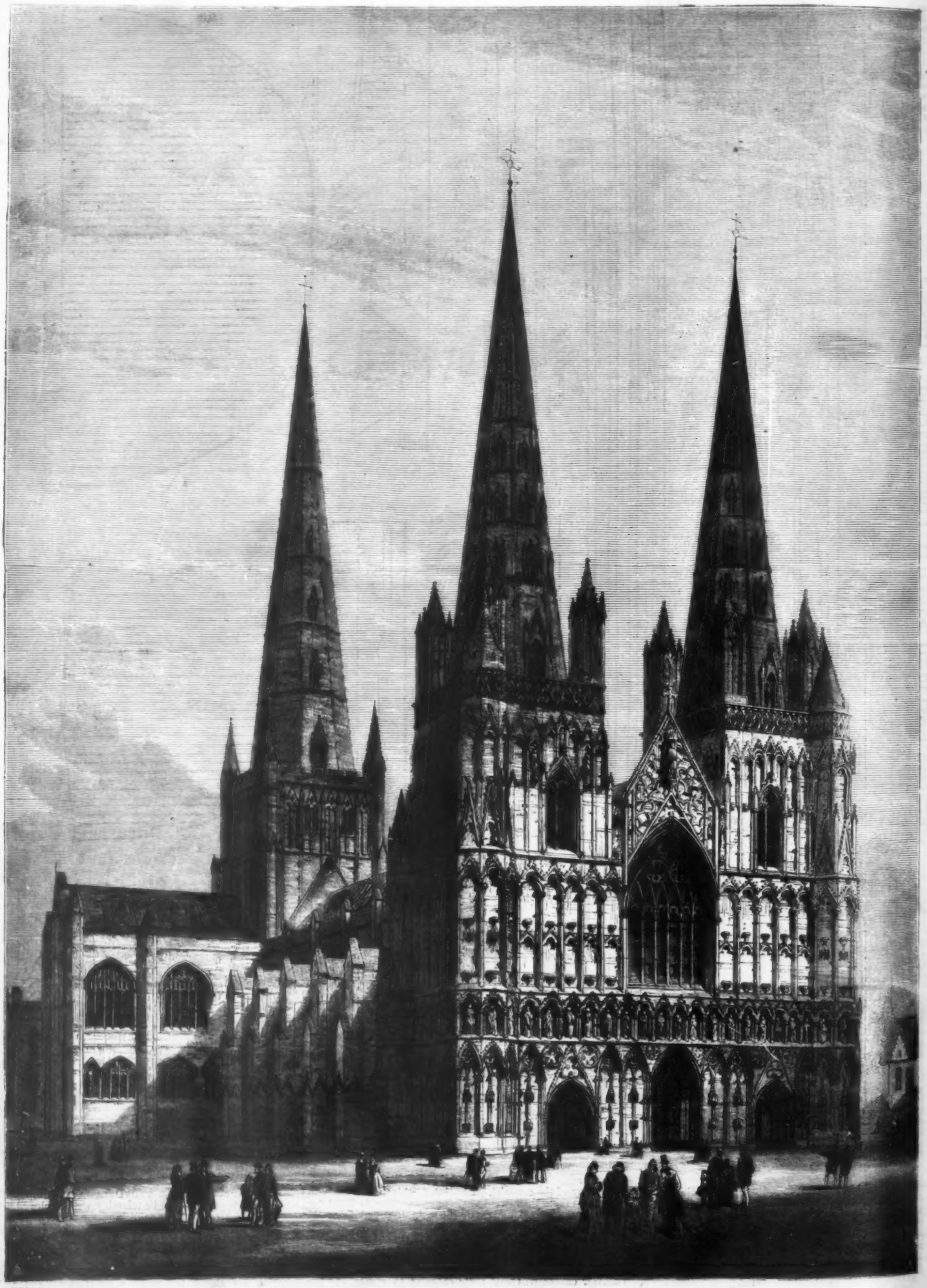


She affords no sleeping accommodations, but will carry a light camping outfit. She carries no rudder to be knocked off. She is the craft for small streams and frequent portages. She will run safely through rapids in which the heavier canoes will treat their captains to upsets. If her captain wants to make distance he can rely upon her—if he be in good form—for fifty miles per day and a half-dozen mile portages thrown in.

IRON SHIPBUILDING ON THE DELAWARE.—Shipbuilders on the Delaware appear to be tolerably well employed. We learn that at Mr. Roach's establishment a large steamer for the Oregon Steam Navigation Company will be launched in thirty days, and will be finished in April. A steamer intended for a Brazil line is partially in frame, while one for the Old Dominion Company will be launched in sixty days. Both the latter are of large dimensions and first class. In addition Mr. Roach has made a contract with Mr. W. Baedar, a member of a large firm of stockbrokers, for a steam yacht of 600 tons and 170 ft. in length, to be finished early in the spring.

LICHFIELD CATHEDRAL.

The three spires of this stately ecclesiastical edifice have often struck the eye of the London and North Western Railway passenger. Its west front, with its successively rising arcades and canopies, in which appear many statues, only reproduced in cement to imitate the former decorations of sculptured stone, forms the subject of our large engraving, drawn by Mr. S. Read. A bishop's see was founded at this town, for the Saxon kingdom and diocese of Mercia, in the middle of the seventh century. St. Chad, more correctly named Ceadda, was the second bishop, following Joruman, who began the pious office at Lichfield after the overthrow of heathen King Penda. The sees of Worcester, Hereford, and Lincoln were carved out of this great Midland English diocese before the Norman Conquest, and that of Oxford at a later period. Coventry was for some time the rival of Lichfield as its episcopal seat; till it was arranged, in the thirteenth century, that the bishop should be elected alternately by the monks and canons of these two places, and should be called "Bishop of Lichfield and Coventry." The decorated Gothic architecture of the cathedral nave, and of the Lady Chapel, are due to Bishop Walter Langton, from 1296 to 1321, who was keeper of the Great Seal and Lord High Treasurer in the reign of Edward II., but much out of favor at court. The choir, of early English style, is a hundred years older, and the transepts correspond with it. This fine



LICHFIELD CATHEDRAL.—DRAWN BY S. READ.

edifice suffered grievously from the violence of the Commonwealth soldiery in the Civil Wars; as Sir Walter Scott says of it,

"When fanatic Brooke
The fair cathedral spoiled and took;
Though, thanks to Heaven and good St. Chad,
A guerdon meet the spoiler had."

It is a fact that Lord Brooke, who commanded the army besieging Lichfield, in March, 1643, was shot dead, by a deaf and dumb brother of Sir Richard Dyott, from the cathedral spire. The town was captured, however, three days afterward, when the interior of the cathedral was gutted, the tombs, stalls, organ, and windows destroyed in wanton mischief. About six weeks later, the Royalist army of Prince Rupert took Lichfield again from the Puritans, and King Charles was there in 1645, after his defeat at Naseby. Restorations were attempted in modern times, and the cathedral is now enriched with beautiful works of carved wood, metal, and encaustic tiles, as well as plaster copies of the ancient sculpture. The late bishop, the Right Rev. Dr. Selwyn, who had been very notable as Bishop of New Zealand, was succeeded two years ago by the Right Rev. Dr. W. D. Maclagan, formerly Rector of St. Mary Abbot's, Kensington.—*Illustrated London News.*

THE POSITION OF THE WATER CISTERN.

IN looking over our questions in the "Intercommunication" column, and the inquiries we receive from correspondents upon every imaginable subject connected with professional practice, we very frequently encounter matters to which it is extremely difficult to give a satisfactory answer at all, and impossible to do so in the narrow limits within which we have found it imperative to restrict the replies of our readers. Sometimes a chance question may involve almost a new field of architectural research, or might form a fit subject to engage the attention of a court of law; at others, we find a short paragraph, to answer which fully would be a suitable undertaking for, say, the professor of architecture in a course of lectures at the Royal Academy; and often enough we get a glimpse of a grievance which the Royal Institute of British Architects would feel great hesitation in meddling with. But there is a class of questions which relate to subjects of importance, hitherto neglected or but little considered, which cannot fail to afford matter for reflection to all thoughtful minds, and which occasionally appear to furnish an excellent theme for an article. To this type of queries belongs one we noticed last week among our "chips," and which was contained in the letter of a correspondent who desired to know "whether it should not be the duty of the district surveyor to see that the house cisterns are fixed so as to admit of easy examination?"

As far as the immediate answer to such a query is concerned, it is needless that we should state that the already overtaxed district surveyor has plenty to do without seeing after the placing of the cistern, though this and a few other matters of scarcely secondary importance well deserve the attention of some properly constituted authority. The district surveyor has quite enough upon his hands in seeing that the Building Act is duly observed, and it would be hopeless to expect him to look after the plumbing—the trade of all others, perhaps, which requires the most careful inspection, and the most minute examination during the progress of the work. The fixing of the cistern and the closet apparatus; the arrangements for the supply of water to each; and the connection of the waste-pipe and the soil-pipe with the drains, are all points for which some one surely should be responsible. At present, however, it is no one's business to attend to this, and therefore it is almost invariably carelessly done; the work is knowingly or wilfully scamped, and sickness and death are too often the results of the plumber's delinquencies; the first intimation which the unhappy householder receives that the sanitary arrangements of his house are altogether wrong being the loss of some loved member of his family by typhoid or some other form of enteric fever—those most insidious and malignant of all the purely preventible diseases.

But to revert to the cistern: the first point which we would urge is that its very existence is from the outset a gross and fatal blunder, a false step which should never have been tolerated—a "survival," perhaps, of the very worst kind. The state of things which makes water cisterns in houses possible is among the most grievous evils of our modern luxury and civilization, and we cannot inveigh too strongly against such an abuse. It is not our object, however, in the present article to show that the domestic cistern is wholly unnecessary and wrong in principle, and that by a constant water supply, which we ought long ago to have possessed, it can be entirely dispensed with; we will reluctantly accept it as a nuisance and a mistake, and endeavor to glance at some of the facts concerning it, which are almost invariably neglected and which can scarcely fail to be productive of more or less serious consequences to the health and comfort of the household.

In nine houses out of ten the cistern is a sort of after-thought, and its place is left to chance; the architect no more thinks of where the cistern is to be put than he considers it his duty to plan the carpets or to choose the furniture, and so the builder's man finds a corner in the roof for it, or puts it above the staircase landing, or over the water-closet, or wherever else he may think such a troublesome and unsightly contrivance will be most out of the way. Of course, this refers to houses of the better class, for among the poor, and even in dwellings up to the value of £40 to £50 per annum, the cistern is almost without exception situated outside the building, often enough accessible only, as our correspondent remarks, by means of a pretty long ladder, which has, moreover, sometimes to be placed at a most awkward and dangerous angle to avoid a lean-to roof beneath. In a suggestive article in the November number of *Macmillan*, which has recently come under our observation, Mr. Torrens, M.P., in treating of the water supply of London, described the actual condition of such an out-of-doors cistern in a locality near the Seven Dials. It seems, he says, "a poor woman, who had known better days, of vigorous age and strong constitution, sickened and died; and the wonder may be not that she died when she did, but that she survived a couple of years, as the tank which supplied her only beverage was found to contain two inches of mud, the decomposing bodies of fourteen rats, a bar of soap, two candles, and many dead beetles." Even in the Mansion House itself, as an instance of what occurs in indoor cisterns in the houses of the wealthy, the civic cistern "was found to contain three-quarters of an inch of fungi scrub at the top, and three-eighths of an inch of mud at the bottom;" while "in a bottle of water on the Lord Mayor's table could be seen hundreds of nematoid worms."

We think that, on the whole, fewer excuses can be found for the exterior position of the cistern than for that within the house. It has replaced the ancient water-butt, filled with the drainage from the roofs, and it is too often found, either in places which are wholly inaccessible to the occupier, or, still worse, in situations where it can scarcely escape contamination of the most dangerous kind—on the roof, we mean, of the privy to which it furnishes the water supply. From cisterns thus situated, probably nearly one-third of the inhabitants of London obtain their only stock of drinking water; and when we reflect on the liability of water to absorb germs and ferments without actual contact, and to become putrid under certain conditions in a few hours; when we remember also the untimely fate of the old lady in Mr. Torrens' story, we can hardly escape a shudder. The outdoor cistern is speedily rendered useless, moreover, by the winter frost, and the wretched owner has to beg all his water from his more fortunate neighbor, or to trust to the chance liberality of the water company in providing a standpipe in the street. Though these exposed cisterns generally have a cover of some sort or other to begin with, it soon rots or is removed or lost, and the dust and dirt and filth of all kinds find their way freely into the tank. This renders the growth of rank, green confervæ only an affair of time, and then we arrive at the picturesque condition of the cistern to be found in most small houses, or which a glance from the window of the railway carriage on any of our high-level lines in London cannot fail to reveal to us.

We have still to deal with the indoor cistern, which was really the principal subject we had in view when we set out. Few houses of any magnitude possess less than three cisterns, and in many instances this number may be doubled. As the cistern has to command as many floors as possible, the most common arrangement is to place the principal reservoir at the highest point to which the company will undertake to deliver the water; too often this level is even exceeded, to the great inconvenience of the household, but this is a question about which we need not now trouble ourselves. The waste from the high cistern forms one mode of supply to another on a lower floor. In the scullery, or back kitchen, sometimes in the front area, is a large cistern which furnishes all the water for cooking purposes, and this fills also a small cast-iron tank to feed the boiler. The boiler supply is usually placed in a cupboard, or on a ledge near the jambs of the kitchen fireplace, and from a considerable experience we can affirm that rarely indeed do we come across one which is not half full of drowned blackbeetles, in every stage of decay. The kitchen kettle is generally replenished from the boiler, and thus the tea, and the hot water, and many other things besides, occasionally get a rather disagreeable twang. It will perhaps scarcely be credited, but it is not the less a fact, and gives us a good illustration of the utter apathy and carelessness which prevail in such matters, that it is no uncommon thing in houses, even of the better class, to find the same cistern used to supply the waterclosets and the drinking water. Moreover, the pipe to the closet is sometimes so arranged, that under certain circumstances which might easily arise, the water in the closet pan would be sucked back into the cistern. The mere possibility of such a state of things is not pleasant to contemplate, and affords the most powerful argument for the provision in every case of a separate cistern for the closets.

Points which must not be lost sight of in the position of the cisterns are the supply for the bath, the housemaid's sink, and the hot water circulating cistern. For these a considerable volume of water at a high level is necessary, and with a little care they may be so arranged as to give good results in a combined scheme.

In modern houses the watercloset and its position has in every case to be arranged by the architect; but in old houses, to which this addition and the water supply required for it have been made after the house was completed many irregularities occur, and all sanitary precautions are frequently set at naught. It is in the houses of the very best and most expensive kind that enteric diseases are most fatal, and that the worst abuses prevail.

It remains for us to indicate the means which should be adopted to make the best of what Mr. Torrens calls, 'the old, foolish, and filthy system of laying in a daily stock" of drinking water. A part of the attic story, if possible, should be set aside as a cistern room. The multiplication of cisterns all over the house, under no sort of control, is an error to be avoided. The floor should be suitably strengthened, not by a chance beam due to the sagacity of the carpenter, and should be furnished with a lead tray turned up three inches all round the edge with a proper waste. This room should necessarily be situated vertically over the kitchen, and should hold the water cisterns and the hot-water cistern, both of them raised only a few inches above the floor-level, so as to be readily examined and cleansed. The room should have a good window and plenty of ventilation, and it is of great advantage to place round it a coil of pipes from the hot-water system, or a flue from the hot-air chamber, to keep out the winter frost. The hot-water tank will, however, generally suffice for this purpose. There should be covers to each cistern, and the tank for drinking water should be entirely distinct from that used to supply the closets. The room should be kept locked, and should be under the master's own control, or in the care of a trusted servant. The cisterns should be emptied and cleaned out at regular intervals of not more than three months, and should, at any rate for the drinking water, be made of slate.

It is a rather instructive study to examine the changes which have taken place in recent times in cistern construction. A hundred and fifty years ago the massive cast-lead cistern only was employed. When lead came to be rolled or milled in lesser thicknesses, it became possible to provide a wooden vessel, lined with sheet lead, at a smaller cost, and the common form of lead-lined cistern came into fashion. An excellent example of a leaden cistern of the old type is preserved in the Structural Museum at South Kensington; it is rather elaborately decorated, bears the initials of the owner or maker, and is dated 1732. Next we had a cistern of sawn slate, grooved by machinery, put together with red lead, and secured by iron bolts; this had a precursor in the old tank formed of stone slabs. Latterly, in all cheap work, the galvanized iron tank is coming into favor, and the 4 ft. × 4 ft. × 4 ft. ship's tank, containing 400 gallons, and made to sell at £4, will never, perhaps, be surpassed in point of economy.

The material of which the cistern is made is, after all, a matter of comparatively trifling importance; the situation in which it is placed is, on the other hand, as we hope we have shown, deserving of careful consideration. Few people, when arranging a pantry or larder, would think of placing it in uninterrupted communication with a privy or closet; and yet it is by no means uncommon, as we have seen, to find all the water for the drinking purposes of the household stored immediately over the closet seat. We trust, in conclusion, that our remarks may have the effect of proving to architects that some little forethought is necessary in choosing the position of the water cistern.—*Building News.*

PORTABLE GARDEN LADDER.

THE ladder shown in the annexed cut is very simple in construction, can be transported very easily, and will be found to be very convenient and handy. Two light carriage wheels are mounted on an axle, D, to which the shafts, C, are attached. The standards, B, rest upon the shafts, and

support the upper half of the ladder, A, the lower part of which is fastened to the shafts, C. A small board, upon which a basket, tools, etc., can be placed, is fastened to the upper end of the ladder. In order to secure great stability, the wheels are placed as far apart as possible.—*Wien. Landw. Zeit.*

NEW PHOTO PROCESS.

IT is pleasant to meet an old friend, and pleasanter still if he brings you good news. M. Poitevin is that good friend, and he steps out of his prolonged retirement from the photographic world to present us with a printing process of some value. It may be termed an argento-iron process, for the two metals—silver and iron—play the principal part therein. From a fine art point of view the process may be imperfect, but as a practical printing method it will be found invaluable for many purposes.

M. Poitevin himself is very modest over the subject. He believes, and with truth, that if his name appears associated with any novelty, photographers will take it for granted that the novelty is worthy of attention. No history of photography would be complete without the name of Poitevin, for it is to him that we owe many of the early improvements connected with collotype printing; so that we are not surprised to find the learned French photographer diffident about making a process known for which he does not claim the highest merits, its object being, he says, merely to facilitate photographic printing, by rendering unnecessary the use of a superior quality of paper and other costly materials; and, above all, by dispensing with the delicate operation of fixing by means of sodium hyposulphite. M. Poitevin, it is true, employs a solution of nitrate of silver, but it is only of one per cent. strength.

M. Poitevin has very clearly described the process, so that we have had no difficulty in carrying it out for ourselves. Certain organic salts of iron are acted upon by light, as our readers are well aware, and this fact has been several times made use of by the experimental photographer. The cyanide, or Prussian blue, process, of which the late Sir John Herschel was one of the first to make use, and in which white lines on a blue ground are secured, is, perhaps, the best known of the iron processes; and that of M. Henri Pellet, who has shown us how to invert the order of things, and produce blue lines on a white ground, is another valuable method of the same character. M. Pellet's method, which has been adopted by many engineering firms in this country for the copying of plans and designs, is one of the most practical before the public.

In the case of M. Poitevin's method, raw paper of any description may be employed. We ourselves experimented with three kinds: ordinary cream-laid, Rive paper, and a coarse scribbling paper. The first named was the least successful, owing, we suppose, to the presence therein of mineral matter or some foreign substance inimical to the process; the other papers gave good results. A sheet is brushed over well with a ten per cent. solution of chloride of iron, and dried. The solution of chloride may be applied by sponge, brush, or rag, and the latter we found to answer perfectly well. The liquid is thoroughly well applied, especially if the surface is of a glazed nature. This operation and that of drying take place in light of day. Next, the sheet is immersed in ordinary liquor ammonia, this operation, for comfort's sake, being conducted in the open, or, at any rate, in a well ventilated apartment. Again the sheet is dried, and, if taken only to this stage, the paper may be prepared in any quantity in the light. To sensitize, the sheets are treated with a solution of citric acid, and are then hung up in the dark to dry.

The citric acid solution is of thirty to thirty-five per cent. strength, and is applied in the same way as the chloride of iron solution, with brush or cloth. The paper is now sensitive, and when dry is ready to go under a negative. We have, in fact, a paper treated with ammonia-citrate of iron. We selected clichés of two kinds for trial: one of a tabular statement that included only figures in black and white, and the other a picture of the hull of a vessel. The time of printing we found about the same as chloride of silver paper, but the Poitevin paper does not blush in the sun. No image appears until the paper is thrown into a solution containing one per cent. of nitrate of silver, when a picture of a dark sepia tint is not long in making its appearance. A final washing in rain or distilled water is advocated

by M. Poitevin, but we employed ordinary spring water with good results.

We tested the finished prints both for silver and iron, and found traces of these metals in the whites; but we are bound to say that it was only after a severe treatment with sulphureted hydrogen that any appreciable discoloration was observed. The result from No. 1 negative was very agreeable, the table of figures was printed in dark brown, and the print being flat, unlike albumenized paper, the sheet could be preserved without mounting. In a word, it was as good as an ordinary silver print without the defects of glaze and cockling. Our other picture was not quite so successful, and made manifest at once in what the process is at present deficient. But it was a nice picture, for all that, with good half-tones and a mat surface; it resembled a platinotype print more than a silver one. There was proof enough that the process had a future, and we have no doubt a more pleasing result still would have rewarded us if we had adopted M. Poitevin's advice, and taken the picture a step further. He tells us that by dipping the print in a weak solution of ferrocyanide of potassium a beautiful print in blue is obtained. A very dilute solution of chloride of gold will in a like manner change the print to a violet color.

We have here, then, a process to which photographers would do well to turn their attention. In concluding his paper M. Poitevin says: "So far as the photo-chemical reaction is concerned, I think the process is complete; there remains now only the artistic question to be solved; that a solution will soon be discovered by our skillful photographers I hope and believe. I invite them heartily to take up and study the process."—*Photo News.*

PAINTING UPON GLASS.

THERE are two ways for amateurs to paint upon glass, viz., with varnish or transparently, in water colors. The first of these is best for windows, and ground glass is best to paint upon. The following colors will be needed, in fine powder, mixed, when used, with picture copal varnish; diluted, when necessary, with spirits of turpentine:

Raw and burnt sienna,	Burnt umber,
Rose madder,	Carmine (or
Brown pink,	Crimson lake),
Yellow lake,	Gamboge,
French ultramarine,	Prussian blue,
Verdigris,	Ivory black, opaque.

A few sable pencils, a flat camel's hair brush, some picture copal varnish, and a little spirits of turpentine are also necessary. The materials being ready, proceed as follows: Lay the glass flat on the print or drawing to be covered, and with a very fine sable pencil and ivory black, mixed with varnish, trace all the outlines. When *thoroughly dry*, raise it to a slanting position, by placing it upon a frame with pieces of upright wood on either side, and a sheet of white paper flat beneath it; by this means the effect of the coloring will be better seen, which may at once be proceeded with. One caution is perhaps here necessary; be careful not to rub up the black in the coloring, as it is liable to smear if much worked over. On this account moist ivory black is frequently, and with advantage, substituted for putting in the outline. It may be used with a pen most conveniently, fine or coarse at the points, according to the nature of the work. When finished, the painting should be fixed up in the windows with the unpainted side outward.

A few hints as to mixing the colors may be useful. The nearest approximation to scarlet is made by the admixture of gamboge with rose madder, crimson lake, or carmine; for greens, verdigris is very brilliant, and almost every shade may be made by adding yellow lake or brown pink in different proportions. When a flat even tint is required, the camel-hair brush is used, and a dabber (made by simply covering a little cotton wool with fine leather), which is particularly used for backgrounds in figure subjects and skies in landscapes, and this applies also to the use of water colors. When the painting is finished it must be varnished.

Painting glass transparently in water colors is decidedly the best method for magic-lantern slides. Plain clear glass should always be used, except for windows, when ground glass may be substituted with advantage. The glass should be washed over with a piece of rag and a little gall; this removes any greasiness there may be upon it. The colors are manufactured expressly for the work.

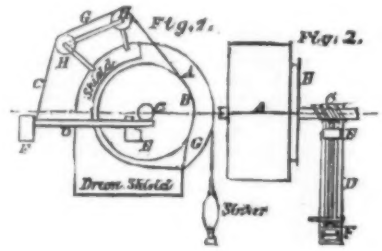
Small subjects are most effectively painted in water colors, as a finish and delicacy are attainable impossible in the use of varnish colors.

The outline should be made with a pen charged with liquid color, containing a small portion of ox-gall, and should be varnished with thin mastic varnish before any attempt is made to work upon it. The colors being placed upon the palette, and diluted with water, we proceed in the same manner as in painting varnish colors. These colors dry rapidly, but it is necessary between each layer of color to give the glass or that portion of it which has been worked upon, a slight coating with varnish, to prevent the second color wiping off or rubbing up the first; for this purpose it is desirable to use the enamel varnish made expressly for glass painting.—*Art Amateur.*

LAYING THE MARSEILLES-ALGIERS CABLE.

THE first cable from Marseilles to Algiers was manufactured and laid by the India-rubber and Guttapercha Company in 1871, for the French Government Telegraph Administration, under the superintendence of M. Aillhaud. It consisted of two types only, shore end and deep sea; but of late, though it has been duplexed after a method devised by M. Aillhaud, the exigencies of the traffic, which now amounts to some 800 messages per diem, have necessitated the laying of a duplicate line. The new contract was also obtained by the India-rubber company, and the cable was made by them during last summer. The French engineers specified that it should have a copper resistance of not more than 12 ohms per knot at a temperature of 75° Fahr., the standard temperature for this kind of measurement; an electrostatic capacity of not more than 0·4 microfarad per knot, and an insulation resistance after one minute charge of not less than 200 megohms per knot at 75° Fahr. It was to consist of a seven-wire copper strand, weighing 106 lb. per knot, and insulated with three layers of guttapercha weighing 139 lb. per knot, the total weight of the core being thus 245 lb. per knot. The core was suitably sheathed with hemp and iron wires. Fifteen No. 13 B.W.G. homogeneous wires, having a breaking weight of 5½ tons, and weight per knot of 1·58 tons, were used for the main or deep-sea type, and for the intermediate ten galvanized iron wires, No. 6 B.W.G., minimum breaking weight 6 tons, weight 3·16 tons, while ten No. 0 B.W.G., homogeneous wires, having a breaking weight of 15 tons and weight of 10 tons, were used for the shore end. The shore end and intermediate types were coated with pitch in the usual way, and the main was served with two layers of tape and then compound. The galvanizing was also tested according to the custom of French electricians in four successive immersions, for a minute at a time, in a solution of one part sulphate of copper to five of water. The cable was shipped on board the Dacia, belonging to the India-rubber Company, a ship specially and admirably designed for cable work by Sir Charles Bright, and built by Messrs. Laird of Sunderland. She is a screw steamer of 170 nominal horse power, with four large cable tanks and five small ones capable of holding 1,500 tons of cable. On September 16, 1879, she laid the shore end at Algeria by buoying it on barrels fastened to it at regular intervals of ten fathoms and towing it ashore, when the fastenings of the barrels were cut one after another and the cable allowed to sink. This plan offers considerable advantages over the usual one of tugging a barge or raft laden with the cable ashore by means of the steam launch, under certain circumstances—such, for example, as the heavy and dangerous surf waves which break on the coasts of Peru and southern Brazil, where even life-boats, let alone steam-launches, are apt to be capsized.

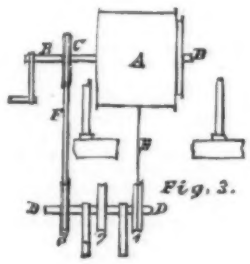
The vast importance of taking soundings beforehand to ascertain the nature of the sea bottom on which such a valuable and vulnerable property as a submarine cable is to be laid has been repeatedly advocated in our pages, and the engineers of the India-rubber Company seem to have been fully alive to it, for ere the main cable was laid, a systematic series of 143 soundings was taken on a diagonal track along the proposed route of the cable. Of this number 93 were taken by the Dacia, night and day, every 7 or 10 miles, the rest being, we understand, taken by the French Administration telegraph-ship Charente. The Dacia soundings were made by means of Sir W. Thomson's pianoforte wire-sounding machine, already detailed in *Engineering* (see vol. xx., p. 41), but with the addition of a novel self-adjusting brake and an arrangement of pulleys for facilitating the picking up of the wire. Figs. 1 and 2 show the arrangement of brake, the different parts being as follows:



A is the drum on which the steel-sounding wire is wound. B is a flange wheel (screwed on drum), and round which the brake strap passes. C is a worm cut in end of drum spindle, working in worm-wheel at end of lever, D. D is the fore and aft shaft acting as a lever and threaded, worked by worm-wheel at C. E is a counterpoise running on guides. The threaded shaft, D, runs through it, and as the drum revolves works it outwards in proportion to the amount of wire paid out. F is a fixed weight at end of lever, D; it regulates the speed at which sinker descends. G is the brake strap, one end fastened to shield, and after being passed round B runs through the pulleys, H H, and is connected to the lever at F. HH are pulleys guiding the brake strap from B on to lever.

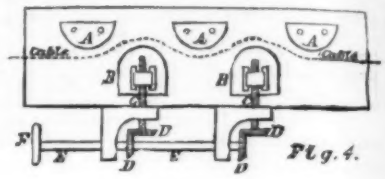
The automatic counterpoise, E, for tending to keep the speed of the descending wire uniform by compensating for the added weight of wire run out is, we think, highly ingenious.

The arrangement of pulleys for furthering the picking up of the wire is shown in Fig. 3, where A is the drum on which



the wire is wound, B the drum spindle, C the pulley on drum spindle connected by a band, F, to pulley No. 3 on lower shaft, and D the lower shaft to which are attached three pulleys—1, 2, and 3. Pulley No. 1 carries the wire, E, when picking up on to drum. Pulley No. 2 is connected to the after steam-winch on board by a belt. Pulley No. 3 is connected to pulley C on drum spindle by band F. E is the wire which, when picking up, is passed round pulley No. 1. F is the belt between pulleys 3 and C. When the steam-winch is required for picking up, this band is tightened by a block and tackle. The belt from the steam-winch hangs loose until required; it is then thrown on pulley No. 2, and tightened by block and tackle. The strain when picking up is thus thrown on the lower shaft, not the drum itself, and the wire is coiled on the drum by means of the two pulleys, 3 and C and the band F. In this way a sounding in 1,500 fathoms of water can be made in thirty minutes or less. In order to show how durable the wire is, it is also worthy of mention that the Dacia wire broke with a stress of 196 lb., after having been in caustic soda pickle for two years. The bottom was found to consist of globigerina ooze similar to that of the Atlantic. Mr. W. H. Preece, who was a guest on board, stated that he had submitted the ooze for examination to one of our most competent biologists, and would report his results to the society, if found of sufficient value. Mr. Preece also remarked on the high temperature of the Mediterranean deeps (54° Fahr.) as compared with those of the Atlantic, which are frequently as low as 0° Fahr., and very aptly likened the former sea to a hot-water bath.

The paying out machinery employed on the Dacia was also improved by one or two novelties. Besides an automatic dynamometer showing the varying strains on the cable, there was a very simple and efficacious "holding back gear" originally designed by Sir C. Bright, and also we believe by Mr. Matthew Gray, but improved by that able and experienced cable engineer, Mr. F. C. Webb. This appliance is illustrated in Fig. 4, where A A A are iron segments

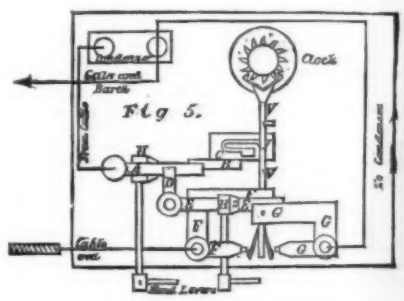


firmly screwed on to a bulk of timber, B B are iron segments worked by screws, C C, which are moved by beveled wheels, D D, attached to the shaft, E.

The pressure and consequent friction which can be applied to the cable, by increasing or diminishing the distance between the movable segments, B B, and fixed ones, A A A, can be regulated by turning the wheel, F, to give any holding-back power required, or to allow the cable to pass perfectly freely.

Another new feature in this chronicle of advances was the use of the electric light for illuminating all the operations on deck; and Mr. W. H. Preece, who is by no means an enthusiast in electric lighting, candidly testified before the meeting to the great success of its application to cable laying. The lamps employed were a modified form of Serrin known as the "Silvertown hand-regulator," and they were fed by two Gramme machines driven by two five-horse-power engines. The result was that the laying operations could be conducted as well during the night as they were by day.

In the electrical department a clockwork key for sending continuity signals every fifth minute between ship and shore was employed, and it possesses several advantages over the old method of signaling by the clerk. This key we illustrate in Fig. 5, in which A is a brass tongue. Its normal



position, while the clockwork is in operation, is on contact plate, B. B and C are brass contact plates. On C there is a spring. Contact is made between the lever, L, and the spring by means of a pin projecting from lower side of lever. There is also a spiral spring between the lever and plate, C, to insure good contact. D is a contact plate, free while clock is working. E E is a brass tongue; its normal position is on contact at G. F is a contact plate to which cable end is attached. G a contact plate to which the earth side of condenser is connected. L, a lever worked by clock, makes contact every fifth minute on an anvil at F, returning after making this contact to G. H^1 is a cam on end of hand lever, used for moving tongue, A, from normal position on B to contact at D, thus switching out connection with lever, L, when signals are to be given by hand. H^2, a cam on end of hand lever, used for giving signals by hand, when clock-work and lever are cut out by pressing tongue, E, down on plate, F, to which cable is attached. When clock is at work the current passes from F to lever, L, on to plate, C, and thence *via* B and A to condenser; when hand signals are given, the current passes from F to E, D, and A, and thence to condenser; when E returns to normal position at G, the condenser is discharged. A clockwork arrangement was, we believe, first used on the Red Sea cable.

For signaling between ship and ship three flags were hoisted for each signal, and a code formed on the basis of the commercial one employed, the words and sentences being arranged in alphabetical order. And here Mr. Marsh Webb called attention to the new regulations of the Board of Trade for cable ships and ships for various reasons not under command. These regulations come into force on and after September 1, 1880, and are to the effect that a cable ship must carry on her mast, in addition to the white lights, three red lights of 10 in. diameter in a vertical line, one over the other not less than 3 ft. apart by night; and three balls or shapes each 2 ft. in diameter by night.

The laying of the cable went on all right until a link in the chain of the buoy attached to the intermediate cable off Marseilles broke just when the work was about to be concluded. From the rocky character of the bottom there some difficulty was experienced in grappling the lost end, but at last it was found and the splice made. The shore end was laid on September 28 into the cable, but at Marseilles up the bed of a stream by means of boats.

Another accident which occurred was the interruption of the older cable by the grapnel of the Dacia while seeking for the lost end, but this damage was also successfully repaired, and it is satisfactory to learn that, when taken up, the older cable appeared as good as when laid, the galvanized sheathing being clean and bright, a fact which speaks well for the preservative properties of a bottom of soft ooze. The cable was soon opened for traffic, and the old tariff for messages has been reduced from 2d. to 1d. per word.—*Engineering.*

STATISTICS OF TELEGRAPHS IN 1879.

THE statement of telegraph statistics for 1878, relating to the countries whose official reports we have received up to this date, are given, made up in the usual form. But little comment in regard to this compilation is needed. For the first time Japan, now entered into the Telegraphic Union, figures in the report. The only change is that the German Telegraphic Administrations (the German Empire proper, with Bavaria and Würtemberg, which, from an international standpoint, are really one) are now included in our statement. As in preceding years, for comparison's sake, we have added the statistics of the United States, or rather that of the Western Union Telegraph Company, representing the largest part of the telegraphic business of the country, derived from the annual report of its president to the stockholders.—*Journal Telegraphique.*

TABLE SHOWING THE EXTENT OF GOVERNMENT TELEGRAPHS IN VARIOUS COUNTRIES, TOGETHER WITH THE RECEIPTS AND EXPENSES FOR THE YEAR ENDING DECEMBER 31, 1878. COMPILED FROM OFFICIAL REPORTS.

OBJECT OF STATISTICS.	GERMANY.	AUSTRIA-HUNGARY. AUSTRIA.	AUSTRIA-HUNGARY. HUNGARY.	BELGIUM.	DENMARK.	FRANCE.	GREAT BRITAIN. Home Office.	GREECE.	ITALY.	JAPAN.	NORWAY.	THE NETHERLANDS. HOME OFFICE.	THE NETHERLANDS. DUTCH INDIES.	ROUMANIA.	RUSSIA.	SWEDEN.	SWITZERLAND.	U. S. AMERICA. W. U. Tel. Co.
Length of Line in Miles	37,364	21,454	9,106	2,345	2,200	26,222	25,611	2,182	15,205	9,008	5,250	2,369	3,400	2,222	46,780	6,777	4,045	23,787
" " Wire " "	126,595	54,797	21,206	14,228	5,200	168,662	113,734	2,200	53,200	9,101	9,211	8,363	4,334	5,003	80,154	17,575	9,905	214,859
Government Offices	5,625	1,564	388	379	127	2,941	6,822	82	1,422	138	197	173	70	92	979	179	264	
Railway and Trivat Offices	2,736	1,400	512	69	127	1,331	1,422		723	12	103	281		91	1,347	236	207	2,536
Total Offices	8,235	2,464	900	648	350	4,772	5,559	92	2,145	149	230	356	70	183	2,326	5	1,001	2,536
Internal Messages sent	6,873,946	2,860,364	1,276,150	1,923,492	979,965	10,972,676	21,722,280	290,736	4,361,130	906,207	491,431	1,644,903	791,818	518,288	4,374,506	678,453	1,890,108	27,070,106
International " "	2,943,760	649,486	344,906	321,311	236,998	1,339,897	1,322,041	25,035	354,490	9,264	115,264	334,849	71,056	164,609	470,027	142,966	200,726	
Total Messages sent	10,817,709	4,212,749	2,430,234	2,244,803	1,216,963	11,312,573	23,065,309	315,771	4,715,622	964,541	606,675	1,979,457	862,874	702,942	4,844,535	818,719	1,890,834	25,070,106
Receipts for Interior Messages	$2,726,548	$883,603	$238,023	$216,075	$30,060	$3,023,970	$5,464,365	$72,502	$1,010,601	$300,764	$166,976	$264,341	$106,603	$82,319	$4,023,961	$212,264	$230,081	£1,990,545
" " International "		$547,270		$226,807	$126,669	$1,660,710	$906,889	$26,024	$479,071	$43,233	$80,711	$128,450	$34,604		$1,446,559	$102,421	$105,151	
Sundry Receipts		$101,125	$158	$6,776	$3,216	$511,272	$474,185		$4,892	$60,466	$3,790		$6,705	$34,976	$182,211	$7,410	$22,836	
Total Receipts	$3,730,349	$1,532,102	$238,181	$441,718	$160,076	$5,234,450	$6,784,440	$98,526	$1,494,564	$404,463	$250,827	$342,791	$196,302	$407,295	$5,652,741	$322,095	$358,068	$10,960,440
Extraordinary Expenditure		$35,231		$15,127	$30,024	$621,729	$1,806,815	$4,540	$18,000	$301,329	$4,195	$33,024	$2,092	$10,494	$478,805	$33,343	$4,400	$4,120,022
Ordinary "		$1,715,592	$742,756	$563,990	$196,080	$3,856,343	$3,431,926	$109,779	$1,340,671	$444,228	$308,184	$320,031	$277,790	$417,671	$4,229,786	$294,419	$754,423	
Total Expenditure		$1,751,823	$742,756	$579,120	$226,074	$4,478,072	$5,238,695	$114,319	$1,358,671	$745,524	$312,379	$353,055	$279,882	$428,165	$4,708,651	$327,761	$758,873	$4,120,022

OUR DOMESTIC POISONS.

By HENRY CARR, M. Inst. C.E.*

THE object in view in this paper is to draw attention to certain poisonous materials, heedlessly introduced into, or intentionally used for some special purpose in our domestic fabrics.

Accidental injurious emanations arising from defective construction of houses, foul air from drains, insalubrious sites, and such causes, would naturally fall under a distinct head, though involving, no doubt, domestic poisoning, in some cases, to a very serious extent. Attention will, therefore, now be limited to poisonous materials used in the process of manufacture and allowed to remain in the finished goods. The evil effects of these domestic poisons have long been known to a limited number, but they are only now beginning to be recognized by the public at large.

It should be stated that the writer has simply attempted to gather such information from competent authorities on medical, chemical, and trade questions, as may be useful when put forward in a collected form. As the question has been raised by a manufacturer, it should be here further stated that neither he nor any of his personal friends have any trade interest whatever in these matters.

The subject of domestic poisons naturally divides itself into two heads:

First, as it affects the public to whom these deleterious compounds are supplied.

Secondly, as it affects the trades manufacturiug and dealing in these articles.

ARSENIC THE GREAT POISON.

The principal materials by which poisonous or injurious matters are introduced into domestic use are arsenical pigments in wall papers; arsenical dyes in cotton fabrics, such as curtains, chintz, tarlatane, etc.; in artists' water colors and ordinary paint; in lithographic printing, poisonous colors being sometimes dusted on. Poisonous colors are also dusted on in coloring tin plate work. Poison is also introduced in artificial flowers, lamp shades, fly papers, in cardboard boxes and labels, now so much used by drapers, stationers, and confectioners; confectioners even attaching poisonous papers to sweets.

Fatal results are reported arising from the use of arsenic in destroying the nerve in teeth, but they appear to be very rare. Paper collars and cuffs are said to be sometimes arsenical, but all attempts to follow out these reports to their origin have hitherto failed.

The aniline dyes produced from coal tar are a source of very serious irritation in some cases when brought into contact with susceptible skins. Lead is a well-known poisonous material, affecting water supply more especially, injurious also to the white lead manufacturers, to painters, and to many susceptible persons when exposed to newly painted rooms.

The sanitary view of the question has been dealt with in the pamphlet, "Our Domestic Poisons,"† already published by the writer of this paper. Some further illustrative cases, however, under this head will be desirable before proceeding to the trade branch, which is the principal subject for consideration at the present time.

Among poisonous substances, the great offender, no doubt, is arsenic in its various combinations; for though aniline dyes free from arsenic produce most serious eruptive disorders, when imperfectly fixed or prepared, they do not affect the general health in the same insidious manner as arsenic. Aniline dyes do not produce injurious effects unless brought into contact with a susceptible skin, whereas the arsenical poison is diffused through the air either as dust or gas, so that injury may arise without actual contact with the arsenical fabric.

Those to whom this subject is new have at first a difficulty in realizing the fact that such small quantities of arsenic, combined in the coloring matter of a wall paper or other fabric, can possibly have any injurious effect, since nothing but a chemical test will detect its presence. The evidence, however, which ought to satisfy any candid observer, will be found simple in the extreme, such as could leave no doubt on the mind of any unprejudiced person as to the verdict to be given.

The symptoms of chronic poisoning by arsenic begin with what appears to be an ordinary cold and cough; dryness and irritation of the throat and frequent headache, extreme restlessness, great debility accompanied by cold clammy sweats, cramps of the legs, griping and dysentery, convulsive twitchings, and a group of nervous symptoms, varying in each case. Inflammation or irritation and smarting of the eyes and nostrils is often the most marked symptom, lasting for days, weeks, or months, sometimes accompanied by irritation of the skin or of the whole mucous tract; sore throat running on to diphtheria, throat ulceration and soreness of the mouth and tongue, irritative fever, which, if persistent, exhausts the patient, and death takes place by collapse. One universal feature should be mentioned, namely, the inefficacy of all usual remedies, the presence of arsenic not being suspected.

The above mentioned symptoms are by no means absolute indications of arsenical poisoning; they may arise from other causes, but if the usual remedies fail to give relief there is reason for suspecting some hidden source of mischief. The proof of arsenical poisoning then depends on the patient's recovery on removal, relapse on return to the arsenical rooms, and final cure on discovery and removal of the arsenical fabric. There is no abstruse scientific investigation needed to obtain such evidence; the facts are plain, within the comprehension of the most ordinary common sense. Illness unaccounted for—failure of ordinary remedies—cure on removal—relapse on return—final cure on discovery and removal of the arsenical fabric.

Any number of cases might be produced illustrating the above position, but a few typical ones can alone be given here. The "nursery paper" now exhibited, with pictures of boys playing cricket, was the cause of the illness of four young children, relatives of the writer. Repeated illness at home, and recovery on removal from home, occurred during a length of time. One of the children died exhibiting nearly all the symptoms above described as the results of exposure to arsenical fabrics. This occurred before the parents became aware of the injurious effects arising from this cause. After communication with the writer the paper was taken down, and the surviving children recovered immediately.

The following is from Robert Brudenell Carter, F.R.C.S., Eng., Ophthalmic Surgeon to St. George's Hospital:

"I have reason to believe that two children of mine died many years ago from an arsenical wall paper in the nursery, but the presence of arsenic was not discovered until after the deaths had occurred."

Case of a lady residing on Sydenham hill, as given by Rev. R. J. Simpson, who himself had previous experience in his own family:

"In March last, Miss S—— moved into a furnished house. A few days after her arrival she was attacked with a slight cold and cough, and, being subject to bronchitis, she confined herself to her bedroom where a large fire was continually kept up. She gradually became worse, and more unpleasant symptoms began to show themselves. She was constantly very sick and suffered much pain. There was a good deal of irritation about the throat and chest, accompanied with difficulty of breathing. The debility was great, and fainting fits of almost daily occurrence. A friend, who remarked the suspiciously bright green paper on the wall of the bedroom, advised her to move into another room. This she did after having occupied the room with the arsenical paper for six weeks. Each day after the change found her better, and she was soon restored to her ordinary health. I may mention that a Persian cat, which was always with her during her illness, was observed to be covered with extraordinary relapses of a severe nature. These relapses always came on after any circumstances which raised dust in the room. The wall paper and the dust were examined by Dr. Stenhouse, and were all found to contain arsenic. The child rapidly recovered after removal to another room.

"Case 2 was that of a gentleman who also had bronchitis, and who, like the child, always became much worse when his children ran about the room, or when, from other causes, dust was disturbed. Paper found to be loaded with arsenic. Recovered slowly after removal to another room.

"Case 3 occurred in a lady of weak constitution, for years has had impaired health. She was suffering from great prostration which steadily got worse. Alarming symptoms presented themselves, the patient fainting many times daily. Sweatings, vomitings, and dryness of the mouth, with intense prostration, almost closed her career. The wall paper of the room being examined, was found loaded with arsenic. With change of air she has now much improved, indeed, she is almost well.

"Case 4. My concluding case was simply one of depression, with pain in the stomach of the most obstinate character. Had the bedroom paper tested, and found the old enemy, the getting rid of which effected the recovery of the patient."

The following is the case of Mr. and Mrs. Clifton, of Derby, as reported by the former:

"In March of the present year, 1879, I had my room papered, but did not occupy it for six weeks afterwards. A few days after sleeping in the room, my wife began to fail greatly in health, and lost flesh considerably; on rising in the morning complained of extreme exhaustion, and frequently vomited; the throat assumed a dark red appearance, the tongue parched, and sometimes cramp or severe pain in the bowels was experienced. Many times during the night I found the heart's action extremely feeble, and the hands and feet cold, and not until I had applied my ear to the region of the heart was I certain it had not ceased to beat. The effect upon myself was different; although, on waking, I felt prostrate, this passed away as soon as I left the room; yet, when I returned at night, the symptoms reappeared, frequent sneezing, and watery discharge from the eyes and nose accompanied by great exhaustion. It did not occur to me until after two months of suffering, that arsenic being present in the paper might have induced some of our ailments. An examination showed that the whole surface was covered with arsenite of copper. On sleeping in the adjoining room the following night, the symptoms referred to ceased, excepting the exhaustion, which has since disappeared, and I have every reason to believe that, had we continued to use the room with the arsenical paper remaining on the walls, no human aid could have restored the balance of health."

The paper referred to in Mr. Clifton's case is now exhibited.

The following is worthy of note, as coming from the trade department rather than from the medical:

"It is an extraordinary thing that, during my 25 years' experience in the trade, I never met with a case of arsenical poisoning among my own circle of acquaintance until this autumn, when a slight case came under my notice. I was at the seaside, and while there engaged apartments for an invalid friend. A few days after my friend had taken possession, a change in the weather obliged her to keep the windows shut. A marked irritation of the throat, cough, and general *malaise* was at once set up, which continued and increased day by day. I tested the paper, found it arsenical, and removed my friend into another room, the paper of which was not arsenical, when the unfavorable symptoms disappeared as if by magic."

Another case has been reported, only just in time for insertion. It is given as a striking illustration of the kind of proof to be relied upon with reference to the injurious effects of arsenical wall papers, namely, illness produced, recovery on removal, return of symptoms on return to the arsenical paper, final recovery on the arsenical paper being taken down.

"I now forward the case of Mr. B——. The paper, since found to be arsenical, was put up in Mr. B——'s bedroom seven months ago. He was taken ill four weeks afterward. The symptoms were remarkably complete; soreness of the eyes on waking in the morning, pain at the pit of the stomach, loss of appetite, emaciation, and general *malaise*.

"I sent Mr. B—— to Margate for change in July, and he came back, as he said, "a man again;" but, at home, the former symptoms soon returned, added to which there were intense dryness of the throat and jaws, swelling of the gums and tongue, followed by excessive irritation of the skin. The symptoms became alarming. The wall paper was tested and found arsenical; it has been taken down, and the patient is now rapidly recovering."

The above cases, excepting that of Mr. Brudenell Carter, are all recent, and are only a sample of the great number

* A recent lecture before the Society of Arts, London.

† "Our Domestic Poisons," Ridgway, Piccadilly.

which have come to the knowledge of the writer within the limited circle of his own acquaintance. They, however, are sufficient to illustrate the injurious effects arising from poisonous pigments, and they alone might almost be considered as establishing a *prima facie* proof of illness arising from this cause; but, when similar cases are multiplied to an indefinite extent, there can be no doubt remaining on any unprejudiced mind. Medical men, whose attention has not been drawn to poisoning by arsenical surroundings, raise the objection that they are in the habit of giving more arsenic as a medicine than can possibly be imbibed from arsenical fabrics. True, they do put more arsenic into the stomach than can be imbibed from a wall paper, and they do it perhaps with beneficial effect in some cases; the legitimate conclusion to be drawn is, not that arsenical surroundings are uninjurious, but that arsenic taken into the stomach does not act in the same manner as when breathed and received through the lungs.

Another difficulty is raised, grounded on the production of arsenic from the mines, and its use in various manufactories in large quantities. It is said that arsenical fabrics, containing comparatively small quantities of arsenic, cannot possibly have the injurious effects attributed to them, for the workpeople continually exposed in these works do not suffer. That many workpeople do not suffer is, no doubt, true, but how many do suffer it is difficult to ascertain. It must be borne in mind that the majority do not palpably suffer from exposure to arsenical fabrics in domestic use, but only a minority of susceptible subjects; nevertheless, that minority is large enough to be an important proportion of the population. Susceptible subjects, attempting to gain a livelihood by exposure to arsenic, would probably soon abandon the employment, thus leaving the work to those who are able to resist it. It is marvellous what the human frame may be inured to, not only as regards arsenic, but other deleterious matter, as, for instance, sewer gas. This gas escaping into houses is universally admitted to be highly injurious, producing, in many cases, a well known class of diseases; but, on the other hand, men whose occupation it is to clear out sewers, spend their working hours breathing the very atmosphere of the sewer itself, and that with perfect freedom from the deleterious effects produced by that same air escaping in small quantities into the house.

As before stated, it is said that workpeople continually exposed to arsenic, in great quantities, do not suffer. It is perfectly clear that great numbers can endure exposure to these arsenical works with impunity, but how many break down, and how many die under the ordeal, it is impossible to ascertain. No such investigation would be at all reliable unless carried out under Government authority, such as that made by Dr. Guy with regard to a manufactory of artificial leaves. (See Report of the Medical Officer of the Privy Council, 1862.)

The following is taken from Dr. Guy's report above mentioned:

"In an establishment employing about one hundred young women, more or less suffering was almost universal among them; the symptoms were erythema, ulceration, excessive thirst, nausea, vomiting, fever, convulsions, etc."

In commenting on this report, and with particular reference to one case of extreme suffering described by Dr. Guy, Mr. Simon says:

"The tortures which that poor girl must have endured will not have been in vain, if, as may be hoped, the public knowledge of them leads to the amendment of a system under which others are still day by day enduring in different proportions the progress of a similar fate."

Had Dr. Guy's investigation been carried into other works where arsenic is employed, further important information would no doubt have been elicited.

It is, of course, only under peculiar circumstances that instances of suffering in manufactories can be reached, and, for the purposes of this paper, any attempt at investigation would have been useless, but the cases of two men accidentally brought under the notice of the writer may be mentioned, whose hands and various parts of the body were covered with scars of ulceration produced by printing papers with arsenical colors, some years ago, the employment of such colors now being abandoned in the factory where they work.

Another case may be given as related by a connection of the writer's, who had the superintendence of the operation in question:

"A quantity of emerald green delivered in large packages had to be redistributed. The work having to be done in haste, four extra hands, men not accustomed to the work, were put on. All had wet sponges over their mouths; nevertheless, these four extra men were made ill, one died soon after, and the other three were far more ill than the men usually employed in repacking colors."

This is a remarkable instance of the difference between men accustomed to such work and others not habituated.

The case of a young woman in a draper's shop, in one of our large provincial towns, is a good example of the serious but less virulent effect of arsenical fabrics in the course of trade. It is this young person's department to sell artificial flowers, and the mere production of them and exhibition to the customers makes her ill, so much so that she has been obliged to leave her work and have change. This report is from a medical man, a friend of the writer's.

As a further illustration of the effect which may be produced by artificial flowers, and as a confirmation of the above statement, it may be well to give the following report from Mr. Charles Ekin, the analytical chemist of Bath, who has kindly also sent the flowers themselves. He says:

"The history of the French flowers is this. They were procured direct from Paris by a lady residing here with her two daughters. When the flowers arrived and were being inspected, one of the daughters, who was rather an invalid, was seized with a violent shivering fit and faintness. She was taken out of the room, and after a time recovered. The mother and other daughters returned to the room and put away the flowers; they remembered afterward that they too felt the same symptoms, only in a much less degree. The flowers were taken out of the box a day or two afterward, and all three were at once affected just as before. The flowers were naturally suspected and packed off to me at once."

The leaves are found to be highly arsenical, but not so the flowers.

The effect of arsenical wall papers on men stripping them off or hanging them is well known; they are frequently obliged to desist from their work. It is stated by Mr. Heisch (analytical chemist and gas examiner to the City of London), who has paid much attention to this subject, that men suffer more from cutting the edges than in hanging the paper; this seems highly probable, for in the one case the dust would be shaken off dry, while in the other it would be rather retained by the damp of the paste.

A very important case has lately been investigated by Dr. Hardwicke, in an inquest on a young woman who died from the poisonous effects of colors used in decoration and printing on tin plate. These colors contained carbonate of lead, acetate of lead, sulphide of tin, metallic copper, antimony, arsenite of copper, and chromic acid salts; the colors were used to a great extent as dry powder, dusted on to an adhesive surface; in this dusting operation, the person was so covered with color as to be described as "not recognizable."

Dr. Bartlett was first engaged on the part of Government to give information on the chemical question, and at a later stage Mr. Lakeman, the Inspector of Factories, was also called in. Dr. Bartlett analyzed the colors, and both these gentlemen examined the works. They pointed out to the manufacturers that the process of dusting poisonous dry colors by hand was inevitably dangerous. It appeared there was no particular blame to be attached to the manufacturers, they merely carried on certain works in the ordinary manner customary in this country; that the process was destructive to the life and health of the persons employed, was no peculiarity of this establishment.

The point to which it is desired now to draw particular attention is this, namely, that Dr. Bartlett and Mr Lakeman having pointed out the danger arising from the use of dry colors, it was stated by the manufacturers on the last day of the inquest, that the process of using dry poisonous colors had been then abandoned. If such a change could be so readily made, why was it requisite that this poor girl's life should be sacrificed in order to enforce attention to these well known facts? One girl produced as a specimen of a healthy subject employed in these works, while giving her evidence was requested to open her mouth, the marks of lead poisoning were at once discovered.

Many cases of suffering are given in a valuable paper by Mr. Frank Draper, of the United States, published in the *Chemical News*, July 19, 1872, and following numbers.

The foregoing statements, with regard to both the public generally and the workpeople, can leave little doubt on the mind of any one, that many lives are sacrificed, and a vast amount of illness produced by this use of arsenic. There are no doubt many employments in which life and health are freely exposed to danger under a sense of duty. The medical man and the nurse expose themselves to infectious diseases; the soldier and sailor to great dangers; workmen in mines, and in various employments, are necessarily exposed more or less to danger; but in these cases every possible precaution ought to be taken, even though the exposure is a moral duty, and the object aimed at be such as to justify the risk. Where the object in view is a great good, not to be attained without risk, the risk is justifiable; not so, however, when it is a mere paltry question, such as whether you have one shade of green paper, or another shade a trifle brighter.

The question, therefore, arises—What is gained? Why is arsenic thus used? Simply, *cui bono?* In considering this part of the question, it is requisite to distinguish carefully between fabrics for home consumption and articles for exportation.

In considering home consumption, we have to deal with the interests of the trade supplying and with the interests of the public using these articles. As to the public, the evidence on the whole tends to show that they do gain some brighter greens at lower prices, that is to say, low class bright green poisonous papers can be produced, brighter and cheaper than non-poisonous. Arsenic is also said to give permanency, brilliancy, and body, especially to the group of aniline colors. The cost of color in low class papers bears an appreciable proportion to the total price of production; but in higher class papers the difference in cost between one green pigment and another is too small to be of material importance. It should, however, be stated that some paper stainers assert that there is no economy or advantage in using arsenical colors.

The samples now hung on the walls will satisfy those present that arsenic is not essential in order to produce a good color; even if it be true that more brilliant tones can be obtained with than without arsenic, the difference is certainly too slight to be appreciated, except by those specially skilled in color.

(To be continued.)

NIAUDET'S NEW CHLORIDE OF LIME PILE.

A PILE, or rather a pile element, or voltaic couple, is, as well known, always composed of two solid electrodes, which are immersed in one or two liquids. One of these two electrodes is always of zinc, this metal being by far the most advantageous of all those which are practically admissible. If we try to substitute iron for it, on account of its lower price, or aluminum, on account of its powerful chemical affinities, we obtain very unsatisfactory results, the electromotive force being notably less. This advantage, which is possessed by zinc, was known to Volta, who employed it in his first pile. It is very possible, however, that in course of time we may succeed in substituting some more advantageous substance for it; but if we do it will prove an important discovery and brilliant invention.

The other electrode is formed of a metal less readily attacked than zinc, such as copper, silver, and platinum. Yet instead of a metal, we may use carbon, which is also a conducting material, although to a less degree than metals. These two electrodes, then, are immersed in liquids, and the role of these we will now explain. The first of these liquids, the only one indispensable, acts on the zinc, dissolves it, and generally oxidizes it. This chemical action is correlated with the production of the electric current, and it is the essential condition of its circulation. As we have before said, the zinc is generally oxidized; a decomposition of water takes place, oxide of zinc is formed, and hydrogen set free. Now the hydrogen is disengaged on the second electrode, and the importance of this fact we will shortly explain. The first liquid is often dilute sulphuric acid, although any saline solution whatever may be employed. One of the best that we can use is that of chloride of sodium, or common salt. In certain countries the battery generally employed is composed of zinc, salt water, and carbon. Some experiments of M. Poggendorff show that a solution of chloride of sodium in certain cases gives an electromotive force superior to that obtained from sulphuric acid diluted with four times its weight of water. Its goes without saying that it is expedient to make use of the most conductive solutions; and, regarded from this standpoint, salt water is one of the best liquids that can be employed. It exhibits, moreover, one important peculiarity, in that it possesses a maximum of conductivity which corresponds, not with saturation, but to a proportion of 24 parts of salt to 100 of water. We have now to explain the role of a second liquid, which, although not indispensable, is yet very useful, as we shall see. We have already said that the hydrogen produced by chemical action was set free from the second electrode. From this there results an increase of resistance and a diminution of electromotive force which concur in producing a reduction of intensity. This important phenomenon has been attributed to the *polarization of the conducting electrode;* and it has been the object of numerous studies by many physicists to overcome it. To effect this, several methods have been employed, the principal one being the use of liquids which would absorb the hydrogen. Of such liquids, solutions of nitrate and sulphate of copper (as in Daniell's battery) are most efficacious; nitric acid (as used in the Grove and Bunsen batteries) is less satisfactory. All other materials that have been used give poor results; for they depolarize the electrode only incompletely, and while, in some cases, they offer some opposition to the reduction of intensity, they do not absolutely overcome it. These general principles being kept in view, we shall be prepared to describe M. Niaudet's pile. In this new battery the electrodes are of zinc and carbon; and the liquids are solutions of chloride of sodium and chloride of lime. The last-named material, then, is here the depolarizing liquid whose mission it is to absorb the hydrogen. Chloride of lime is a substance which is produced in large quantities in the industries, and is used both in bleaching and as a disinfectant. It is a mixture of lime, hypochlorite of lime, and chloride of calcium. The hypochlorite of lime is alone active, the hypochlorous acid that it contains being composed of oxygen and chlorine, which both combine with hydrogen to form water and hydrochloric acid. The latter acid attacks the lime and produces chloride of calcium. The use of these materials has the important advantage that all the substances which form are soluble, and thus the liquid remains limpid. As may be seen also, even the lime becomes in time transformed into

NEW CHLORIDE OF LIME PILE.

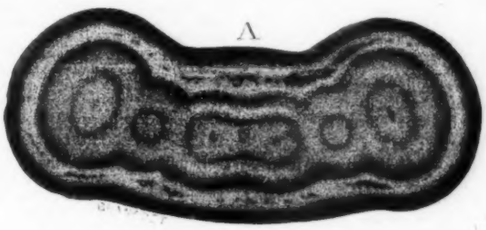
chloride of calcium—one of the most soluble substances known.

Another capital property of these solutions is that they have no action on the zinc, so long as the circuit is open; and consequently during the interval that the pile is not in operation, it is attended by no expense. In an economical point of view this feature is of great importance, and is the opposite of what we find in the Daniell battery, which is otherwise so near perfect. The electromotive force of the chloride of lime pile is considerable, and equals 1·6 volts, or, in other words, superior to one-and-a-half Daniells. The truth is, the pile is not absolutely depolarized; for when, in a slightly resistant current, it is closed, it becomes weak. But it regains its first strength very perceptibly after quite a short period of rest. In the majority of applications, however, it behaves as if it were completely depolarized. Chloride of lime, as well known, has a disagreeable odor; so it has been found necessary to close the vessel containing the pile by a stopper covered with wax. The glass receptacle contains, as shown in the annexed figure, the carbon immersed in the solution of chloride of lime held in a porous cup; and around the latter is rolled the zinc, which in its turn is immersed in the salt water. The zinc and its strip are all in one piece, being cut out of the same sheet of metal, while ordinarily a strip of copper is soldered to the zinc, thus forming a local couple which is prejudicial. The zinc is kept at an even and very short distance from the porous cup by interposing small plugs of wood, and these are held between the central cup and the zinc by means of cords tied around the latter. Owing to the latter fact the zinc does not reach the bottom of the liquid, where, as shown by general experience, there form local couples which result in active waste and a consequent pure loss.

NEW PHONEIDOSCOPIC EXPERIMENTS.

M. ADRIEN GUÉBHARD has recently shown an elegant method of procuring iridescent rings in a permanent form. These rings which, like Newton's, are due to interference giving rise to the "color of thin plates," differ, however, from Newton's rings in reversing the order of the colors, that corresponding to greatest thickness being in the center. M. Guébhard drops a little collodion on to the surface of mercury. It is drawn out on all sides into a thin film of iridescent hue, which, when hard, may be floated off on to paper. M. Guébhard produces similar rings, though of no permanency, with drops of volatile mineral oil on the surface of mercury, or even by the film of moisture condensed from the breath. At the meeting of the "Société de Physique," of Paris, on Dec. 5, these experiments were shown by projection upon the screen, and a lively interest was awakened when the experimenter proceeded to show that such films, especially the fleeting films condensed from the breath, may exhibit phoneidoscopic properties. The various vowels being pronounced so that the breath impinges on the surface of the cooled mercury, rings are obtained having certain forms more or less strongly characteristic of their different qualities of tone. M. Guébhard's method of procedure, as well as illustrations of the figures obtained, we borrow from an article by him in a recent number of *La Nature*. The experiments under consideration, says he, may be performed with the greatest

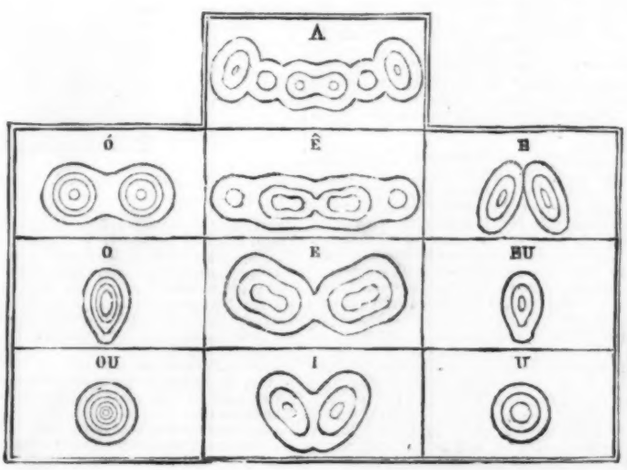
case, and without the aid of any special apparatus. All that is needed is a saucer of mercury, and it is not materially essential that the latter be strictly pure. Remove the gray pellicle of oxide and dust with a piece of cardboard or paper, then breathe upon the brilliant mirror. Provided that you be not situated under exceptionally unfavorable conditions as regards light, you will see appear a magnificent system of colored bands, the bright shades of which will reproduce, with an incomparable brilliancy, the well-known Newton rings. But instead of the four or five "irises" that the great astronomer could separate only with great trouble, you will clearly distinguish six or seven; and, from the thin brown border up to the rose and green which precede the white that reflects the central films, you will have the whole chromatic scale in its completest entirety.



PHONEIDOSCOPIC FIGURE OF THE BROAD SOUND OF THE VOWEL A.

Here at once suggest themselves hundreds of possible applications and hundreds of experimental arrangements. For instance, let us suddenly direct the blue flame of a Bunsen burner on the surface of the mercury, and we will have —delineated in brilliant lines—the classic figure of the structure of flames. A long central space, absolutely free from any aqueous deposit, will clearly figure the reducing portion, while, all around, fine colored bands will depict the distribution of chemical and calorific effects.

But it is especially in the study of vocal sounds that this new process will prove of direct utility. In fact, the aerial currents which are naturally saturated with moisture, and which produce the so varied phenomenon of speech, are capable of printing on the mercury true phoneidoscopic diagrams; and from these we may obtain facts regarding their internal structure which are entirely new. At first sight we remark the diversity of figures obtained for the different vowels, and the relative constancy of these, independently of tone, for each particular vowel. It is an easy means of obtaining figures of the sonorous utterance, and one which we might look for in vain elsewhere in studying the vocal cord. In the production of vowels it is not, as might be supposed, the outer orifices—the mouth and dental arches—which determine the form of the current, but it is more especially the tongue and palate. It is easy to convince ourselves of this fact by putting the opening between the lips out of shape by some means or other; for example, by inserting between them and the gums pieces of folded paper, so as to completely suppress the action of the teeth. We may, for instance, with little trouble, succeed in pronouncing the vowels *au* and *ou* very distinctly with the mouth stretched so as to form a narrow longitudinal slit, without for all that perceptibly altering the oval or circular form of the corresponding figures, which always preserve their unique center. (Fig. 2.) The fact is that the number of centers is one of the principal elements of comparison; and as regards these, we obtain a surprising constancy, by using a few very simple precautions. The vowels must be uttered in a very clear tone for two or three seconds, but without any effort, and with as natural an arrangement of the organs as possible, and this may be easily done by making preparations slightly in advance, just before bending over the mercury. The utterance must be sufficiently strong,



PHONEIDOSCOPIC DIAGRAMS OF THE TEN PRINCIPAL SUB-VOWELS.

and the distance sufficiently small, to prevent the jet of vapor, by virtue of its elasticity of tension, from having time to get sensibly out of unison with the warm current which serves it as a vehicle; otherwise we should always obtain that circular form toward which, according to the researches of MM. Tresca and Bazin, solid, liquid, and gaseous jets so quickly tend.

But two or three trials will show better than any explanation the means of obtaining good results, and the experimenter will very quickly succeed in forming for himself a table showing a collection of the figures characteristic of the vowels, as I have myself done in Fig. 2 as a mean of several hundred experiments, renewed under the most varied conditions.

(It should be stated for the benefit of the reader, that the vowel sounds here figured by the author are those of course which obtain in the French language.)

A NEW PHONEIDOSCOPIC PROCESS BY MEANS OF COLORED RINGS.

By A. GUEBHARD.

IN a recent communication the author described the production of colored rings by the condensation of watery vapor on the freshly cleansed surface of impure mercury. He finds that these bands of color may be applied to the study of the internal movements of masses, and of the vibration of masses, being much more sensitive than pulverulent bodies. Vocal currents, in particular, impress upon the mercury characteristic diagrams, some of which are figured.

THE CENTRIFUGAL MILK-TESTER.

THE usual method in vogue of ascertaining the quality of milk is by the use of the lactometer, which, to obtain accurate results, requires a skill and care of manipulation that

is not possessed by every man, nor indeed by every woman. To provide some method, by means of which not only the falsification of milk, but also of other food substances, may be speedily detected, and that too unerringly, and without the necessity of any manipulatory skill, the Messrs. Lefeldt, of Schöningen, Germany, have invented an ingenious apparatus, which we find figured and described in the *Wiener Gewerbe-Zeitung*. This very simple little machine, which is called the "Centrifugal milk-tester," consists, as shown in the annexed figure, of a balance wheel, to which is riveted a single cross-piece, and which is set in motion by a winch. The cross-piece is provided with receptacles, into which are inserted two graduated glass tubes, open at the top, closed at the bottom, and resembling the test-tubes used by chemists. These are held firmly in place by means of steel spring clips or brass-wire loops. To make the test, the glass tubes are filled with the milk, closed with cork stoppers inserted in the clips, and the wheel made to revolve with great velocity. Through centrifugal force the milk will be found, in one or two minutes, to have separated into its constituent parts—water, butter, casein, and salt. The glass cylinders are now allowed to remain at rest, and in a short time the quantity of the constituents may be read off on the graduated scale, and the quality of the milk as compared with a normal specimen may be at once ascertained. By this means any degree of falsification may be readily detected. The apparatus may also be used for accurately ascertaining the purity of other food products, such as honey, oil, lard, etc.

The apparatus may be constructed of any kind of metal, but it is so simple that it may even be made entirely of wood by almost any turner.

ACTION OF POTASSIUM PERMANGANATE UPON POTASSIUM CYANIDE.

By E. BAUDRIMONT.

IF standard solutions of these bodies are allowed to react upon each other, the author finds: that the decoloration of the permanganate has a necessary limit; this decoloration is facilitated by an elevation of temperature and the concentration of liquids; its limit is attained when 2 equivs. KCy are in contact with 5 equivs. of permanganate. The action is less rapid when the liquids are acidified with sulphuric acid. The products formed by the mutual reaction of the salts differ in their proportions if not in their nature. Those whose presence has been ascertained are urea, the carbonic, nitrous, nitric, oxalic, and formic acids, and ammonia, due to the decomposition of the urea. The quantity of urea increases the more the mixture is acidified with sulphuric acid.

SYNTHESIS OF MILK-SUGAR AND CANE-SUGAR.

By E. DEMOLE.

SETTING out with the idea that the glucose molecule of cane and of milk-sugar are different, the author endeavored to take a further step in the synthesis of these sugars by combining, on the one hand, levulose with dextro-glucose, and on the other galactose with lacto-glucose. In the second case he has succeeded. Milk-sugar was first resolved into two isomeric bodies, galactose and lacto-glucose, by the action of dilute acids. The product of this reaction, after removal of the acid, was evaporated and carefully dried, and was found to possess all the properties of a mixture of equal mols. galactose and lacto-glucose. It was treated with three parts of acetic anhydride in an apparatus provided with a cohobator, and heated to the boiling-point until totally dissolved. On subsequent treatment, a body was obtained possessing all the properties of octacetyl-lactose.

ON REGENERATIVE GAS LIGHTING.*

A lecture delivered before the Society for the Promotion of Industry in Prussia, by HERR F. SIEMENS.

As early as 20 years ago, at the period when the results of our heat-regenerative furnaces were first demonstrated, I had some thoughts of using the same means of economizing the combustible materials used in the production of light, and

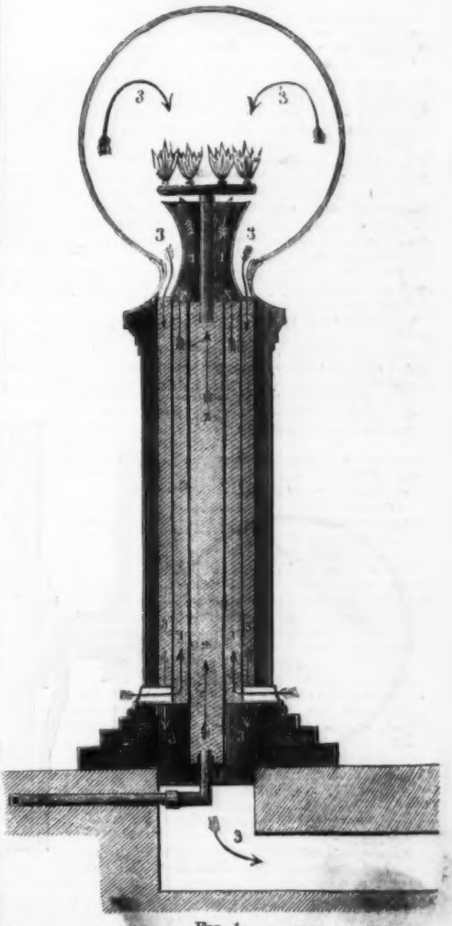


FIG. 1.

with a view also of obtaining a light of intense power. The want of success which attended the experiments made at that time seemed to prove the impossibility of properly sup-

* The *Journal fur Gasbeleuchtung* for December published the original, from which our translation has been made. The illustrations, too, have been reproduced from our German contemporary.—*Ed. Journal of Gas Lighting.*

plying a gas-flame with heated air, owing to my supposition that double glasses or chimneys, one within the other, were necessary in order to bring the combustion gases and the fresh air together, and the inner glass could not withstand the heat. Later experience of regenerative gas-furnaces taught me to utilize the natural currents of gas and heated air within a large clear oven or furnace chamber, to obtain better combustion of the gas; and, consequently, the former system of separate combustion chambers was entirely abandoned. It was found that a direct or artificial conjunction of the gas and the air in a special mixing chamber was very disadvantageous, not only with regard to perfect combus-

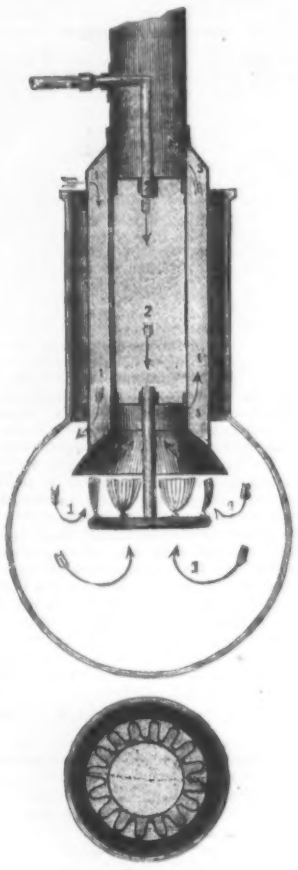


FIG. 2.

tion, but also to economy of fuel and the durability of the furnace, and was in every way inferior to free combination caused by natural currents. The regenerative principle could only be applied to lighting purposes by taking advantage of the automatic motion of air, gas, and the products of combustion at different temperatures. The introduction of the electric light and the opportunity thereby created for the employment of burners of higher lighting power led me to return to this subject. The first experiments made with the mixing arrangements on the principle just described clearly proved to me that it was possible to obtain very satisfactory results by simple means.

I will now describe the three varieties of apparatus actually constructed, and the accompanying drawings show four varieties of them.

Variety A (Fig. 1) is a pillar lamp, which, as may be seen by the drawing, consists of three concentric tubes, surmounted by a glass globe. At the lower part of the globe is an ordinary burner, with six radial flames. All the space in the tubes is filled with wire netting, which I call regene-

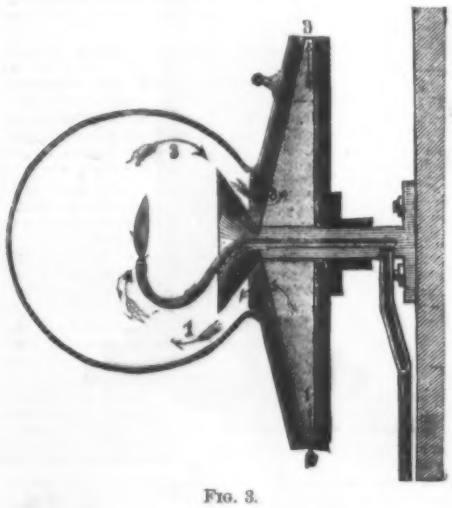


FIG. 3.

rators, and which serve either to abstract heat from passing gases, or to communicate heat to them. The middle pipe being the gas supply, the air is admitted from below into the second annular pipe, and, passing upward into the globe, is there burnt with the gas. The products of this combustion pass away down through the annular space of the outermost pipe into a chimney or aspirator flue. (The arrangement and course of the currents are shown in the drawing.) The wire-net regenerators in the annular space of the outer pipe are thus heated by the products of combustion as they pass away from the globe, and this effect is specially marked in the upper part of the wire work. The heat thus extracted is communicated by conduction and radiation to the regenerators in the air-pipe, and also through the side to the inside gas-pipe. Air and gas are thus pre-heated, and this pre-heating increases in proportion as the temperature of the flame, increased by the pre-heating of air and gas, increases the temperature of the regenerators in the outer pipe. The increase of temperature, and consequently of the illuminating power of the flame in the globe, continues until the cooling effect of radiation balances the production of heat.

It is necessary to explain the fact that the highly heated products of combustion, rising upward in the globe, turn therein and pass away downward, without affecting the flame or the air supply. This is explained by the rising flame taking the hottest passage in the middle of the globe, while the combustion products, in passing off, naturally take the coolest way, along the inner surface of the globe.

Variety B, in the style of a chandelier (Fig. 2) is constructed on the same principle, but adapted to the different circumstances of the case. Air and gas enter the globe from above; and the former automatically passes along the inside of it, joining the flame in the proper manner. The products of combustion in this case pass off directly upward. Instead of concentric pipes, the chandelier connection has (see cross section) a sheet-iron tube so arranged that air and the products of combustion, in alternate divisions, pass through the regenerators, in order to obtain as close contact as possible for the due interchange of heat. The arrangement as a chandelier necessitates better means for the transmission of heat than are required in a pillar lamp. This is due to causes which will be better understood when I have fully explained the automatic currents, as I intend doing later.

Variety C (Fig. 3) represents a regenerative oven on the true principle, the same regenerator surfaces which have absorbed the heat of the combustion products communicating it in turn to the cold air required by the flame. There is only the superficial distinction that the entire oven changes its position instead of the draught. It will be seen by the drawing that the regenerator is in the form of a plate round the horizontal gas-pipe, which serves also for a spindle. The flame is in the center of the plate. The air necessary for combustion enters the regenerator at the lower edge of the plate, and flows automatically to join the flame, while the products of combustion pass off through the upper portion of the same regenerator. The upper portion of the plate will thus become heated, and can be made to heat the air directly by being continually turned slowly round, so that the heated portion gradually comes below. This style of burner is specially adapted for throwing light in one direction, as a reflector of brass, gun-metal, or china may be used as shown. As either a hemispherical or entirely globular glass may be used, fixed to the generator or to the spindle, and the flame is fixed in its center, this design is also as well suited for throwing light in all directions as the previously described varieties, A and B.

A number of other designs might easily be added to these. The heat regenerative system is also applicable to petroleum, solid luminants, and other substances. An alteration which would be very useful in certain circumstances could be made by using the apparatus, C, just described, for the production of hot air only, which could be drawn off and used for burners in various places. I can prove the possibility of such a method of lighting by an experiment with variety A, taking off the glass globe, and allowing the flame, supported by the hot air from the regenerator, to escape into the open air. The illuminating power of the flame would soon decrease, because the heating of the generator is suspended, and the air supply soon falls to its usual temperature. You will have perceived already that the principle can be used in unlimited numbers of ways, and it is but right that I should point out that the subject is far from being exhausted; but, on the contrary, the applications and advantages of the heat regenerative system, as applied to lighting purposes, have been here set forth only as actually proved by the first incomplete but highly promising trials.

I promised to return to the automatic currents. As already mentioned, these currents are regulated by their temperature, and the temperature of the surfaces with which they come in contact, and I have utilized them for a long time with great advantage in my regenerative gas-furnaces, especially in furnaces for melting and annealing glass. By the proper utilization of these currents the most complete combustion and most uniform temperature are obtained in the furnace; and, on the other hand, the completest possible exchange of heat in the regenerator can be established. Without going more closely into the particulars of furnace working, I will examine the effect of these currents in the three above-described apparatuses (A, B, and C), after which you will be able to draw your own conclusions as to other means of utilizing them.

In variety A the automatic currents are made use of in the manner already mentioned. The flame and its products rise straight upward, the gases produced being hot and of small specific gravity. At the top of the globe they encounter a natural obstacle and turn downward, unless this movement has been previously induced by the action of the draught. As, however, the hot gases or combustion products have little inclination to move downward, they will, when compelled to do so, take the coolest way—viz., past the inner surface of the globe. The upward and downward currents in the ball keep as widely separated from each other as possible. The peculiar effects of the automatic currents are also shown quite as favorably in the regenerators of variety A. The downward currents of the hot combustion products always take the coolest way, their specific gravity being greatest there. The upward currents of hot air, on the contrary, take the hottest course. The consequence is that regenerators are always uniformly heated in horizontal layers. The stream moving downward as well as the one moving upward always tend to keep as near as possible to the surface of the pipe by which they are separated, because directly on the surface of this pipe is to be found the heating influence for the rising current, and the cooling influence for the downward current. With this arrangement the exchange of heat is, therefore, as complete as possible. The general conclusion may be drawn from this that the regenerators must be arranged as nearly vertical as possible, with the hot end at the top and the cold end at the bottom. The results arrived at also prove that such a regenerator system, when placed upside down, effects but a very incomplete exchange of heat; and it is for this reason that in the variety B, where the cold end is at the top, the division-plate is so arranged as to artificially assist the contact between the combustion products which have to be cooled, and the air supply which is to be heated. Hence this design is less suited for giving a very intense light, and the arrangement is made only because circumstances sometimes require a lamp to be suspended overhead. This design, moreover, has the advantage that the globe does not become highly heated and never blackens, its interior being exposed only to clean though hot air.

In variety C the system of natural currents is modified. The heating of the air in the generator takes place in the proper manner from below upward, and the currents in the globes take their natural course; but the absorption of heat is opposite, in consequence of the upward course of the combustion products in the regenerator. This unfavorable circumstance is, however, completely counteracted by constantly revolving the apparatus at a uniform rate by machinery or clockwork. The combustion products are thus prevented from taking hot channels in their upward course, because new and cold surfaces are continuously brought into position by the constant revolution.

There is another and very important fact which requires close examination, in view of the successful application of the regenerative system to lighting purposes. There is much heat radiation from the visible flame, but very little from the transparent and invisible products of the flame. For this reason a very large glass globe may be used without incurring any great loss of heat. The invisible combustion products which appear to have a low temperature keep the regenerator glowing hot, as may be seen on inspecting the apparatus. It will also be readily understood that specially designed obstacles, such as the wire netting, for example, are necessary for abstracting and yielding up the heat of these invisible gases, contact of which with such obstacles should be as frequent and intimate as possible. Hence the incompleteness of a system of heating air by passing it through plain tubes where it meets with no obstruction. This fact can be readily proved by experiment, and I have in fact utilized it with considerable success in my glass ovens, the sides of which have to be kept cool by currents of air.

I will now exhibit to you another mode of lighting. Va-

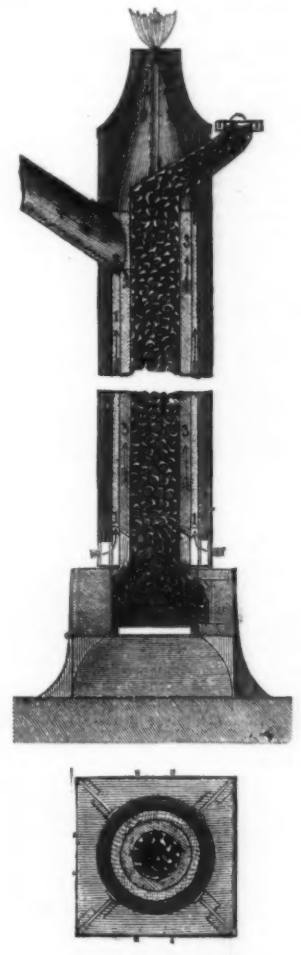


FIG. 4.

riety D (Fig. 4) represents a vertical gas-lamp and retort combined, in which the burner is supplied direct from the coal. This apparatus is designed for use in the open air, for which it is the more suitable, as neither chimney nor fixed attachments are necessary, and it can therefore be employed anywhere. The general arrangement will be clearly understood from the figure. It consists mainly of three concentric pipes, the inner being filled with coal and the outer ones with regenerators. The three pipes, which are of nearly the same length and connected together, are placed over a furnace, so that the two inner pipes are open to the fireplace, and the outer, which is closed to the fire, stands over it as shown. The inner pipe is provided at the top with a branch, which passes through the other tubes, and is closed at the end with a cover and water seal. This is intended to receive the charge of coal which drops through the inner tube to the furnace below. At the upper end, above the branch, this tube is closed with a thick plate, through which passes a vertical gas-pipe. The second or intermediate tube, open below, is closed at the top. Below its termination a branching chimney takes off the products of combustion from the furnace. The outer pipe, which is fixed over the furnace, without having any connection with it, but admitting air by a circle of holes at the bottom, closes round the gas-pipe at the top, where it has an orifice in the same horizontal plane. The outside pipe and the furnace are surrounded by a non-conducting coating, so as to retain the heat as much as possible. When the inside tube is filled with coal, and the feeding branch sealed, the furnace is lighted, and the flames, etc., pass up through the intermediate annular space, and find an exit at the chimney, heating in their passage not only the regenerators in the tube but also the coal in the retort and the air regenerator or outer pipe. The gas thereby expelled consequently burns at the top, together with the

heated air from the outer pipe. The heat of the gas flame in this case escapes without further use, which is really not material, because the combustion of the coke produced in the retort gives sufficient heat not only to gasify the coal above it, but also to preheat the necessary air for the burner. I reserve, however, the power of utilizing the heat of the gas flame also, if required, by removing the products of combustion through an outer pipe, as in variety A, and providing a separate chimney.

To avoid lighting the furnace afresh each time that the light may be required, I extinguish the burner by an air-tight cover, and similarly close the chimney and the ash-door of the furnace. No further consumption of coal then takes place, but incandescence continues on the fire-grate for several days, and it is therefore only necessary to put in fresh coal and open all the orifices in order to obtain light in from half an hour to two hours.

This arrangement has been chosen for explanation because of its simplicity, but in reality a more complex design appears to offer greater advantages. It would, for example, be easy to increase the height of the layer of coke in the furnace, and so produce carbonic oxide gas instead of the usual products, and to arrange a ring of holes in the middle tube for the admission of air to burn this gas. The bottom of the tube would not then burn so quickly, and a uniform heating of the retort and the outer air-pipe would result. The burner could also be provided with double air draught, whereby the intensity of the light would be augmented. Several burners could also be used. When unpurified gas is employed and a fire is also possible, it will be seen that this application of my system of regenerative lighting, combined with a gas retort, is very economical and will produce a good light. I consider it of great advantage in open street lighting and for large areas, and to assist in lighting up large works. Stoppages can only arise from accumulations of tar or soot in the gas pipe when it is not carefully cleaned each day during use. There is no danger even in case of obstruction at this point, for the gas would then escape at the bottom, and pass up the intermediate tube.

I think I have given a clear idea of my system of lighting and the apparatuses in use, to which I give the name of "Light-accumulators," and also of the principles on which they are based. I will therefore only add a few words respecting the globes to be used. Though only the flame, and not its products, radiates heat, yet the glass is made very hot and is easily cracked. To avoid this I harden it so as almost to entirely overcome its tendency to fracture. As regards the intensity of the light, I can safely state that it is at least six times greater than in ordinary gas-burners, but the exact determination of this I leave to more skilled observers. I may, however, point out that the power of the light at present produced is no criterion of the future development of my system, since the apparatus used is still incomplete, and the intensity will be found to vary in different arrangements.

At the conclusion of the lecture the following discussion took place:

Dr. W. SIEMENS: I will offer a few remarks as to the rotative generative apparatus (C). The best mechanism for causing it to revolve is still to be found, but I think it might be done easily by electricity. I am of opinion that, with a suitable motor, this form is the best, for all the others have the disadvantage of requiring a special chimney. The wonderful effect of preheating in increasing the illuminating power is most conspicuous. The same phenomenon has been observed in the electric light. The increase of light at high temperatures takes place very quickly, so that an increase of temperature alters very considerably the proportion between heat and light radiation. That the lighting effect of the same gas is increased from four to five times by means of regenerative heating over the usual method can only be explained in this way. I do not think there will be any very great competition between the three methods of lighting, viz., common gas, gas which has been preheated, and the electric light. Each has its own field, where it will be found most suitable, and there will even be places where all three kinds can be successfully used together.

Mr. F. SIEMENS: It must not be supposed that this method of lighting is suited for every purpose, because it is not so divisible as ordinary gas-lighting.

Mr. ELSTER said that, as the difference between the light given by the French and the usual burners did not prove so great as was at first anticipated, it could hardly be supposed that this system would give four to five times more light.

Dr. SIEMENS: It is, however, quite possible, because the burners hitherto used are not based on the principle of regaining the heat of combustion and using it for the flame. That is the difference. Any one can test it. When the flames of two movable brackets, each with a fishtail burner, are approximated to each other, a very bright light is obtained, but when the flames are separated again the light becomes disproportionately less.

Mr. DRUCKENMÜLLER: How is it with the heat evolved?

Mr. F. SIEMENS: There is proportionately no more heat evolved, but only the intensity of the flame increased. The flame is, of course, hotter, by giving more light and radiating more heat; but 100° C. more heat makes, on the other hand, a very great difference in illuminating power. The temperature of ordinary gas-flames is 1,600° C., but even 1,700° is a very bright light indeed, and 1,800° is probably the temperature of the electric light.

At the close of the meeting the different regenerative apparatuses were exhibited. Mr. F. Siemens' statements as to their illuminating power were confirmed, and their designs appeared well suited for many of the purposes of lighting.

PNEUMONIA.*

Two lectures delivered at the College of Physicians and Surgeons, New York, by ALONZO CLARK, M.D., LL.D., Professor of Pathology and Practice of Medicine.

LECTURE I.

PNEUMONITIS, pleuro-pneumonia, lung-fever—these are some of the names by which it is known, all referring to one affection. When we say pneumonia we mean the same thing as when we say pleuro-pneumonia. The pleurisy which accompanies the pneumonia is implied when the term pneumonia alone is used, but pleuro-pneumonia is more descriptive, because pleurisy almost always goes with it. But of that by and by.

We say in general that pneumonia is an inflammation of the lung, but we can be a little more definite than that; it is an inflammation of that portion of the lung which serves the purpose of respiration—the functional portion of the lung. It is an inflammation of the lining membrane of the areolæ, as they are called a good deal nowadays, the air cells, and intralobular passages. I have already told you there is almost an abrupt termination of the ciliated epithelium of the bronchial tubes as it gets down into the lungs proper. The ciliated epithelium ends almost abruptly, and then comes pavement epithelium, very small, each particular cell not larger than a blood corpuscle. These line the air cells and form a new structure, distinct from the ciliated epithelium. The ciliated epithelium is now no more wanted, but an exceedingly delicate membrane is required, through which the elements of the air can pass, and through which the gaseous material in the blood can pass, the carbonic acid gas for example, to pass out, and the oxygen to pass in. And you can easily comprehend that a delicate structure would be necessary for such a purpose. These intralobular passages are irregular tubes into which at the sides and ends the air vesicles open. Clusters of air cells communicate with this intralobular passage, or bronchiole (two names for one thing), and this particular structure is the lung. In other words, it is the particular part of the organ in which the function is performed. That is the part which is the seat of pneumonia proper. To be sure the vessels that are outside of this lining membrane, that is, the seat of the changes, the functional vessels of the lung, become the seat of stasis, and from them the effusions take place.

A pneumonia generally begins in the lower portion of the lung. Not usually exactly at the bottom, but pretty well toward the bottom, and it spreads in both directions (if it does not begin absolutely at the bottom) until it occupies the whole inferior portion as well as the upper. It may occupy the whole of one lobe, and no more; it may pass the septum of the lobes and occupy a second lobe; it may, indeed, occupy the whole of one lung.* It is the right lung that is most subject to pneumonia; it is more frequently affected than the left—not as I once supposed in two-thirds of all the cases, but in a very large majority. And the inferior portion, in a very large proportion, is the seat, as I have intimated. But there are instances in which pneumonia is called superior; in other words, instances in which it begins in the upper part of the lung, in the upper lobe, and extends downward.

Pneumonia does not commonly affect more than one lung at a time, and yet we are not unfamiliar with double pneumonia. The lung becomes either half of it useless, or two-thirds of it, or possibly the whole of it. It performs no function when the inflammation has come to its maturity; it does not receive any air in that part of it which should aerate the blood. Air enters the bronchial tubes and goes out again and makes a noise which enables you to recognize the pneumonia, but it does not enter the part where the function is performed. That is all plugged up, filled full of material that perhaps has just been consolidated; it is almost as firm to the touch as the lung itself. The lung increases in weight very greatly, consequently a portion of lung affected with pneumonia will sink in water; the healthy lung floats on it, as you know. It is estimated that a portion of lung affected with pneumonia, at its maturity, weighs ten times as much as the same portion in a healthy condition.

The lung is expanded more or less by this process of inflammation. There is an effusion into its cavities, into the air cells, that distends them to a certain degree, and this pushes the lung against the ribs, and when you make a post-mortem examination of a person who has died of pneumonia you find the indentations of the ribs in the surface of the lung. The lung has pushed out the intercostal spaces, but it could not push out the ribs, and therefore the lines formed by the ribs are imprinted on it. Then, again, in listening to a patient who has pleuro-pneumonia you hear no friction sound indicating the pleurisy. The reason of that is that the lung is pressed against the ribs so firmly that it does not move up and down; it only has an expansive movement.

Now, the changes taking place when a pneumonia is forming can, perhaps, be best explained by a reference to the structure of the air cells themselves. For example, suppose this to be one of the bronchioles (making a diagram), and suppose here is an air cell that opens into it, the vessels are all about here; they form an outside coating, so to speak. These vessels are the seat of a stasis more or less complete, and an effusion begins in a manner described earlier in the course. It makes its way through the lining membrane of the air cell, and makes a coating on the inside, in the periphery of the air cell, and this goes on until the air cell is actually filled. Of course during this time there will be some of this plastic material (that is to be converted into a solid matter) at the opening of the air cell, so that when the air enters it will have to break through and cause a noise like the bursting of a bubble. This air cell becomes, then, in time, completely filled, and others in the same way, filling up always from the periphery and condensing toward the center.

When this air cell is full an interesting question arises: What fills it? You can take out on the point of a needle the material which fills one of these air cells, put it under the microscope, and examine it, and I may say here that these granulations that fill the air cells make a rough surface upon the torn lung. If you take one of these plugs and examine it by the microscope you will find always three things: First, a granular body, looking like a pus corpuscle, but less granular; it appears to me larger than a pus corpuscle. It may be a form of pus corpuscle. I have called it pneumonic globule for want of a better name, or at any rate until it gets a better. Then, second, you find cast off epithelium. As the inflammatory effusion comes through the lining of the air cell it pushes off this very fine epithelium; and third, you will find in addition in this little plug some blood corpuscles of natural (?) appearance. Those are the three things you are sure always to find; the pneumonic globule, that substance looking very much like pus globule, but less granular; the epithelial scales, and blood corpuscles. This is an inflammation in which blood is always effused—not much, but enough to stain the plug that fills the air cell. In grown up persons you will almost always find, in addition to these three substances, a considerable amount of fine, granular matter, hardly having form, except rounded to a certain extent. This may be visible fibrine, or it may be in some instances the material of the plug partly broken down. In children this granular matter is not usually seen developed at the time you are likely to make the examination. This material fills not only the air cells, but the interlobular passages also.

Now, in this you observe I have not said one word about fibrinous effusion, and I have not said one word about it because there is not a particle of it here. It is the fashion nowadays to denominate the kind of pneumonia that I am describing as *croupous* pneumonia, and one of the persons who calls it by this name was kind enough to define what he means by croupous pneumonia. He means an inflammation in which false membranes are formed. There is not a vestige of false membrane in the plug that constitutes the pneumonic granulation. I can have no patience with those who adopt that name, because it is altogether false. I do not know how the observant Germans ever fell into the error. They have examined as many pneumonic lungs as I have, I have no doubt. The phrase croupous pneumonia is being adopted by the profession all over this country. This being true, they should certainly have a definite idea attached to it, but let it be understood that in *croupous* (?) pneumonia there is no croup at all. The small bronchial tubes are sometimes lined with false membrane, but the air cell and bronchioles never.

The interesting part of this history now comes in tracing this particular plug that has filled up the air cells and the intralobular passages in its changes. If you take a lung that is affected with pneumonia, recently removed from the body, and make a section of it and leave it in a place overnight where the air is damp and warm, you will find that the red color is changed to gray, and if you cut down to see how far that change of color has penetrated, you will find that it is a very small fraction of an inch. Shave off an eighth of an inch of the surface that has changed color and you will get red again; leave that for a time in the same moist, warm air, and it will undergo a spontaneous change to gray again. It is a common understanding with the profession that if the gray hepatization—I have not given the divisions of pneumonia yet, but I may anticipate this—occurs, it is invariably fatal, so in substance says Watson, that it is a purulent infiltration. Now, gray hepatization is absolutely necessary to the recovery of a person who has the red; there is no way to get from red hepatization to health but through gray hepatization, but I will demonstrate that to you as I go on.

Now, as the pneumonia goes on, the first change that takes place in this plug is that it loses its color, just as the pneumonia lung exposed to the damp, warm air, loses its color, and for the same reason change occur in the hæmatine of the blood that causes it to lose its red color, and indeed to have no color. The blood corpuscle remains, but is colorless. You may find some difficulty in distinguishing it from the epithelium that has been thrown off from the wall of the air cell. You will make the distinction, however, from the fact of the red blood corpuscles being rounded, the epithelium being shaped so as to match other scales of epithelium. The lung thus becomes gray, and in the first period of its losing its color it is still firm—no softening; but as time goes on two to four days are enough to produce breaking down of this plug, and the breaking down is effected by the healthy action of the blood in the blood vessels; stasis is removed, the blood begins to circulate healthily in this tissue of vessels, and the irritation of this plug causes a serous secretion from this wall of the air cell, which will soften and gradually cause removal of this plug. A part of it is expectorated; I suppose in young persons almost the whole of it. Now, if you take some of this expectorated matter and examine it by your microscope side by side with a specimen from the dead house—that is, a recently inflamed lung—you will find that the patient has coughed up just those same materials that are found in the lung and nothing more, except what comes from the bronchial tubes and the mouth, but the blood coloring matter will not be there. This plug softens and is removed, and new epithelium forms upon the wall of the air cell, and now everything is restored as good as new. Pneumonia leaves no secondary marks in the lung. The lung, I say, is as good as ever. It is true the pleuritic effusion may cause adhesion, but the lung itself is fully, completely restored.

Now, you are ready for the divisions that have been given to this disease. There is the first stage, and there is a first stage before that, but I will not confuse you with that just now. There is the first stage, or the stage of engorgement; a second stage, or stage of red hepatization; a third stage, or stage of red hepatization, and in this your books, almost all of them, will tell you there is purulent infiltration. I told you that there is no more purulent infiltration in the third stage of pneumonia than there is in the second. Whenever that pneumonic globule is found to be a pus globule, then there is purulent infiltration in the second stage of pneumonia, and it is continued into the third.

Now, mark these stages as indicated by the changes in the lung. The first stage is that period during which the effusion is filling the air cell, the inflammation has begun, it has made a certain degree of progress before the technical first stage of pneumonia begins, and that leaves room for me to say that there is a stage before the first, in which generally there is an œdematous effusion. The first stage—technical—is after the œdematous effusion, so that in truth it would not be wrong to make five stages of pneumonia instead of three, one preceding the technical first stage, one following the third; but of that by and by.

The first stage occupies all the time during which the air vesicle is being filled by this new material. A portion of this new matter is pushed out of the inflamed parts, finds its way into the breathing tubes, and so out, and makes the pneumonic expectoration. The characteristic pneumonic expectoration then comes from the bronchiole air cell before the new material is dried into a plug. Then, from the moment the effusion begins in the outer border of this air cell the first stage begins, and it continues all the time that this air cell is becoming filled. Now, all the affected air cells, supposing them to have a history occupying the time, are filled, and the breathing portion of the lung is solid.

Now begins the second stage, or the stage of red hepatization, as soon as the air cells are filled full, and that continues until the color changes, and at first there are no physical signs to indicate that change of color. The physical signs will be the same until softening of the plug begins. You will have the gray hepatization when the color changes, and you will have a softening as a part of it. If I were to divide pneumonia, then, into stages, I would make the first the stage of œdema; the second stage, the filling of the air cell; the third stage, the full air cell of a red color; a fourth stage, the full air cell of a gray color; a fifth stage the breaking up, or breaking down, and emptying of these air cells of their plugs.

The fact that you get in the expectoration during the resolution of a pneumonia the same materials that you find in a recent completed inflammation, by a microscopical examination, is pretty conclusive proof that there is nothing added to the contents of the air cell during the technical third stage.

Now, you are prepared to follow me through the physical signs that indicate these several stages. I will not burden your memory with the new classification, but will adhere to that which is given in your books and in your general teaching. I made this division that you may see there is something more to it than is commonly described.

I have been somewhat repetitious in this description of pneumonia, because I wish to impress on your minds

* Reported for the *Medical Gazette* and revised by the lecturer.

certain points that you cannot find explained in your text book.

LECTURE II.

I was explaining to you at the end of the hour when we were last together the relation between the anatomical changes of pneumonia and the physical signs. I had begun by saying that as the air cell becomes gradually filled with a material that is to become consolidated, while it is yet semi-fluid it permits the air to pass through it, either at the opening of the cell or in the bronchioles, so that a bubble or septum is broken, and a fine crepitation is produced. The first physical sign of pneumonia, then, is a fine crepitation, a crepitant rale, just like that which is produced in the smaller bronchial tubes in bronchitis. You cannot, therefore, make a distinction between bronchitis and pneumonia at this point, by the physical signs. The process of filling this air cell is going on steadily for perhaps a day, or a day and a half, and during this time until the cell is filled (after which time it will exclude the air), you will continue to have this crepitation. It is possible you may not get it except at the end of a deep inspiration; it is possible you may have to tell your patient to cough, and listen to the breath he takes before the coughing, which will be a full one. It is heard on inspiration only. But at length the air cell is filled, and its contents dried, forming a plug, and you can easily conceive that the access of air is cut off. After this plug is formed you have no more crepitation, unless it comes from an accompanying bronchitis; the respiratory murmur is gone, as well as the crepitation. The reason of that is, that the respiratory murmur is formed in the air cell, or in the intralobular passages, and these are filled full, plugged up wholly. But you now get a voice sound, and a breath sound, that are important. In anybody's breathing with a good deal of the spongy structure of the lung between your ear, when it is applied to the chest, and the bronchial tubes, you hear nothing of the bronchial breathing; that is, you hear nothing of the noise produced by the air passing through the bronchial tubes; you hear barely respiratory murmur which is produced between the bronchial tubes and your ear, but if by any means you can make this spongy substance of the lung a consolidated one, or nearly consolidated, you will get a conductor of sound, and you will be able to hear sounds (?) not exactly from the deepest portion of the lung, but from a portion that lies under the superficial portion. As I breathe now there is a sound produced in my bronchial tubes exactly like that which you hear in pneumonia, but if you were to place your ear to my chest you would not hear it, it being covered or masked by the overlying lung and the respiratory murmur produced in this. Now, I say this respiratory murmur is gone, and the crepitation is gone unless it is produced in the smaller bronchial tubes, which is not very infrequent. But, in place of it, you get a blowing sound, a tubular respiration; you get the sound of the air passing through tubes. It is called bronchial breathing, and you hear, also, when the patient speaks, what is called bronchophony. This all you who are familiar with the Greek language will perceive means nothing more nor less than voice in the bronchial tube. It is rather a loud, somewhat ringing sound. The bronchial breathing, then, and the bronchial voice, or bronchophony, are developed by the consolidation of the lung and belong to the second stage.

During all the first stage, that is, the period during which the air cells and the intralobular passages are being filled, you have a gradually increasing dullness on percussion. As soon as the walls of the air cells begin to be covered by this plastic matter, which is the result of inflammation, the resonance of the chest is diminished, and it goes on diminishing until the intralobular passages and the air cells are filled, and then dullness is completed. You have then three signs at the beginning of the second stage: bronchial voice, the bronchial breathing sound, and nearly absolute dullness on percussion. This dullness continues until these plugs are gradually softened and they begin to be removed. It continues through the first part of the third stage to the period when the rales begin to return, in other words, until the plugs begin to be broken up. Then there will be a gradual diminution in the amount of dullness until the lung is clear. I told you the last time we were together how this plug is broken up by the serous secretion coming from the restored vessels through the lining membrane of the air cell; a serous fluid that infiltrates this mass, and softens it, causes it to break down, and finally brings it into a state in which it can be forced into the bronchial tubes, whence it can be coughed up. In this connection it is important to say that certain persons have pneumonia and do not raise anything. They are almost always persons advanced in years. In them the lung may clear up and be as sound as ever it has been; nothing is raised. There is but one solution of that problem, and it is this, that these plugs are not only broken up, but dissolved and carried away in the circulation, and it is possible that this process takes place in every pneumonia to a certain extent, leaving the residual material to be expectorated.

Here, then, we have for the first stage crepitant rales and growing dullness; for the second stage no rales at all unless they are produced in the bronchial tubes, and dullness on percussion, bronchial voice and bronchial breathing. For the third stage, in the earlier part of it, after the lung becomes gray, the same signs exactly; but when the plug is being broken up then there will be a return of rales. They will not be crepitant rales alone, but crepitant, subcrepitant and mucous, all mixed together. And it has been found convenient, for the sake of having one name to cover the whole, to call this the rale-redux, the return rale. This continues until the lung is pretty well cleared out, until the air cells are emptied of their inflammatory contents, and then, after this, occasionally there remains a finer crepitant rale than that which belongs to pneumonia; but in most cases with the end of the rale-redux you have the end of the physical signs, the resonance being restored. But, in a few persons, I say, you will find during their convalescence, when they regard themselves about well, some very fine crepitant rales, particularly when you listen closely to the back. This is on account of the presence of some of the serous fluid which remains after having performed its function, namely, the breaking down of the plug.

To distinguish between the crepitant rale of pneumonia and the crepitant rale of bronchitis, you have these two things to bear in mind, namely, that the crepitant rale of pneumonia occurs in one lung only, at any rate, at first. We have double pneumonia, to be sure; that is, pneumonia may occur in both lungs in the same sickness, but it will not begin in both lungs at the same time. If you have double pneumonia, inflammation will be developed in one lung a day or two, or three, before it occurs in the other. Sometimes the patient is convalescent when it attacks the other lung, but more commonly it occurs in the progress of the first, so that even double pneumonia will not, in the beginning, confuse you. Then, again, the crepitant rale of bronchitis being double, is associated with resonance on percussion, there being no dullness. Then, too, the expectoration is different, but it is a little too early to consider that.

The physical signs of pneumonia, then, are pretty clear. Taken in connection with the febrile movement, you have very little difficulty in making up your mind what you have in hand.

Now with reference to the rational signs. These, too, are pretty manifest. Except in drunkards and certain feeble persons the primary pneumonia is indicated by a chill. The first symptom is often a chill. M. Grisolle studied this matter in two hundred and five cases at the Hotel Dieu, and found that in all there was a chill, and that in fifty there were certain signs of illness before the chill, so that in certain cases you may have some feelings of uneasiness, called by the French generally, *malaise*, a feeling of sickness coming on before it becomes well marked. The chill varies in length, is commonly pretty sharp, and the temperature is already elevated, although the patient feels cold. The thermometer will indicate that his temperature is rising. This chill is usually followed by a pain in the side, and a general febrile movement. The pain in the side is developed in all cases where the pneumonia begins upon the surface of the lung. In certain instances, however, the inflammation begins centrally in the lung; that is, at a distance from the chest wall and gradually works outward and comes to the surface at a later day. Then there will be no pain at first. The pain is the result of the pleuritic affection that is associated with the pneumonia. The lung itself does not seem susceptible of pain in any great degree. The febrile movement rises pretty rapidly. It is common to find about as high a temperature as you would expect in the course of the disease at the end of twenty-four hours from the beginning of the chill. The temperature rises to 104°, 105°, 106°, or even to 107° sometimes. 106° is about as high as it will ordinarily rise. The febrile movement is attended by an exacerbation in the evening and a remission in the morning, a difference of between one or one-and-a-half degrees. This is one of the features of typhoid and also of typhus fever—an afternoon increase of temperature, a morning remisaion. Not that this affection is in any intimate way allied with typhus or typhoid fever, but there is a coincidence with reference to the period of the greatest heat.

The pulse is increased in frequency, as you would naturally expect with the increase of heat. It is not a disease, however, attended by a remarkably rapid pulse, except in the fatal cases, and then the rapidity is toward the end. One hundred to 115 is about as high as you would expect to find it in an ordinary case.

The tongue does not become dry early, but in the severe cases, and particularly those that have a typhoid type, it does become dry, remaining so a considerable portion of the day, and often moister in the morning.

The position of the patient is almost always upon his back.

There is something marked in the expectoration—indeed, characteristic in many cases. It is not very abundant. It seems to be just the overflow of the effusion into the air cells, and its characteristics will be these: First, it is viscid; it adheres to the cup into which it is discharged; one sputum adheres to another, making a pretty uniform mass in the vessel. It is semi-transparent, as a rule; you can see the bottom of the vessel through a moderately thin layer of it. Some little air bubbles are imprisoned in its substance. But the most characteristic thing is the color. This is not absolutely uniform, but perhaps the most common is some tint of yellow, suggesting to you that perhaps the patient has been eating orange peel; some hue of yellow up to some hue of red, and on to a prune-juice color. Sometimes it is compared in color to brick-dust; it looks as if some brick-dust might have been mingled with it, but not to absolutely obscure its translucency.

These are the characters, then, of the characteristic expectoration of pneumonia, and when you find it you may be pretty sure that your diagnosis is correct. The characteristic expectoration occurs in a great majority of cases of pneumonia, but in certain instances in which pneumonia is complicated with bronchitis there may be a pretty abundant secretion from the bronchial tubes and the pneumonic expectoration be lost, be buried in that of the bronchitis.

Then again, the condition of the urine in pneumonia is a matter of some importance. When it is severe you may pretty confidently expect that the urine will contain albumen; and probably casts. Then, again, it will lack one of the salts that habitually appears in it, namely, the chloride of sodium or common salt, but that salt will appear in the expectoration, whether it is that the expectoration draws it off and exhausts it, or whether there is something in pneumonia itself affecting the kidneys that prevents the elimination of it there, I do not know.

Again, a person who is severely sick with pneumonia may become delirious, and I refer to that because at one time in my professional life, rather early, I had met with a considerable number of fatal cases in which delirium was developed in the last day or two, and I had come to look upon it as a fatal symptom. I do not now think of it so gravely. It is a sign of imperfect aeration of the blood, and uræmia, which have deranged the action of the nerve centers, and that is all, but that implies danger.

There is another source of danger. When one lung is so obstructed that the blood circulates with difficulty through it, it is not uncommon that the other becomes overcharged with blood, and there is danger, therefore, from the lung that you call the well one. The obstruction to the circulation through the right lung, for example, will cause a large current of blood to flow to the left, and this not unfrequently is attended by œdema of that lung, and, of course, this increases the danger to your patient.

A word in relation to "typhoid pneumonia." You hear a good deal said about it. It does not mean a special kind of pneumonia. The lesions of typhoid pneumonia are exactly those of the pneumonia that I have described to you. It is simply that in certain instances typhoid symptoms predominate—those symptoms that are observed in typhoid and typhus fever; that is, there comes a dry tongue, there may be sordes upon the teeth, there may be a rapid and small pulse, and a low delirium. When many of the symptoms of typhoid fever come to be united in pneumonia it is rather the fashion to call that particular case a case of typhoid pneumonia. It is regarded as a graver disease than common pneumonia, but bear in mind that it is common pneumonia with the typhoid developments—not typhoid fever ingrafted upon it, but merely there are some of the symptoms that are observed in typhoid fever.

(*To be continued.*)

PHYSICAL FUNCTIONS OF LEAVES.

By E. Chevreul.

Among the conclusions which the author regards as established are: that the transpiration by both surfaces of the leaf is greater in the sunshine than in the shade. With the exception of the oleander and the maize plant, which exhibit in this respect an anomaly, it appears that in the numerous species experimented upon, if the transpiration from the upper side of the leaf is represented by unity, that of the reverse equals 4·3. In the shade, however, the proposals are as 1 : 2·4. The leaves of the chestnut, of maize, and of the periwinkle transpire equally on both surfaces. It has been already demonstrated that plants absorb solutions of the salts necessary for their growth, not merely by the leaves, but even by the petals of their flowers.

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